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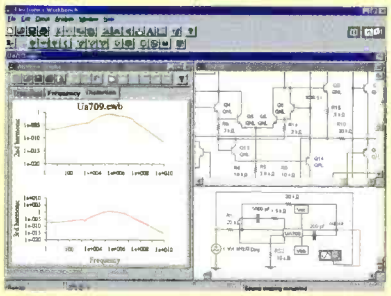

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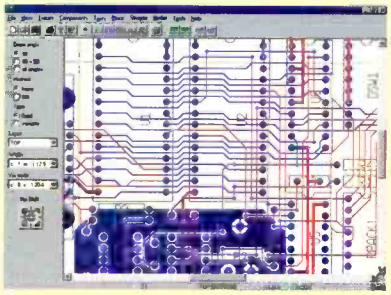

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JULY 1998
Vol. 15, No. 7

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JULY 1998

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EDITORIAL

Oops—Doomsday Has Been Postponed!

Back in March it appeared that the Earth was headed for a cataclysmic disaster with untold losses in life. Why? Well, asteroid 1997XF11, about 244 million miles away, was on a rendezvous orbit with planet Earth. When? Thursday, October 26, 2028 at 1:30 PM (EDT). Initial calculations by astronomers indicated that this newly discovered 1–2-mile-wide celestial body was headed towards Earth and might pass as close as 30,000 miles, or might be on a direct collision course! "The chance of collision is small...but not entirely out of the question," a scientist was quoted. Another scientist's comment on the asteroid was "It is big enough to cause immense devastation. You are not talking about wiping out a city, you are talking about wiping out a continent." Later that day, besides lame jokes about the futility of long-term insurance, Hollywood announced that two films on related disasters would be out this Spring. On a serious note, scientists outlined a backup doomsday plan, such as launching a rocket to explode near the asteroid, to slightly divert its orbit and ensure that 1997XF11 would miss the Earth by a wide margin. That night I am sure many people had a very troubled sleep.

Then suddenly the next day, I awoke to hear that the Earth was presumably saved. New calculations revealed that 1997XF11 would get no closer to Earth than 600,000 miles (the Moon-to-Earth distance is about 250,000 miles). Another astronomer now declared the chances of the asteroid hitting the Earth were "less than zero." Do I feel safe now that this cosmic false alarm has been canceled and that the previous day's calculations were in error? I am not sure!

Speaking of errors, it is interesting to note that we at **Popular Electronics** occasionally get letters from our readers vehemently pointing out some errors that we, or our authors, make in a published construction project or in a circuit design. One reader accused some authors of cleverly leaving out software files so that the programs described can never be compiled unless you purchase the routines from the author. Well, all we can say is that we always honestly try to publish the most complete and accurate information in our magazine. Once any corrections are verified, we post them on our Web site *www.gernsback.com* (under the Forums link), informing you about a month or two before the correction gets published in the magazine. And if we mess up once in a while, unlike the astronomer's forecasting the orbit of 1997XF11, we don't have to worry about predicting a global disaster.

Ed Whitman
Managing Editor

LETTERS

CD-AMP CORRECTION

I am an electronics student, and I think I found a discrepancy in the article, "Build this Portable CD Amp" (**Popular Electronics**, May 1998). The bridge rectifier output is a little high. It said 18.6-volt output, when it should be 16.9 volts, disregarding the diode drops.

C.L.
via e-mail

You certainly deserve an "A" in your electronics course. Your comment about the 18.6V output on page 40 is completely correct. The correct voltage is 1.414 × 12 = 16.97 VDC ideally. Fortunately, this really doesn't affect the unit's performance, as it will work for supplies from 12 through 20 VDC. Thanks for your interest in ***Popular Electronics****.—Editor*

FLYBACK TESTER RECIPE

In response to D.B.'s request for a reliable, economical flyback tester in the *Letters* column in the May issue, I have a suggestion.

Connect a bare wire to an oscilloscope vertical. Apply a very small square wave to the flyback primaries. Use dropping resistors if spot goes off screen. You will see electronic "ding-a-lings" just like bells make in a microphone. No dings equals a bad coil.

R.G.
Aurora, IL

MORE "SPARKS" ON BATTERIES

The "Product Test Report" on alkaline batteries (**Popular Electronics**, January 1998) was very interesting and informative. I have some questions about the test. How many batteries of each brand were tested? If more than one was used, were the results of multiple tests/cycles averaged?

A.C.
via e-mail

Three batteries of each brand were used in the test. Yes, the results were averaged.—Editor

In regards to the letter from J.S. in the May issue, what he is seeing on his battery contacts is *not* a result of corrosion produced by the battery contacts reacting with the holder contact material. This is caused by electrolyte leakage from the cells!

After many years of research, most major battery manufacturers have pretty much eliminated cell-leakage problems—except for the Duracell brand. Their alkaline cells appear to leak at

random! This leakage appears even after mild discharge, making long-term storage in a device a risky proposition. I've seen them leak in their original blister pack after a couple of years, and after I saw a few of my battery holders ruined (including an expensive remote control) I quit using them.

I've only seen this occur with "AAA"- through "D"-sized cells, and that only sporadically. Alkaline 9-volt batteries seem to be immune to this problem. Duracell is a great energy-producing battery, but it definitely needs work on the leakage problem. The competition appears to have it solved.

S.C.
S. Bound Brook, NJ

I have a comment on the battery question from J.S. in the May issue. The Duracell contacts are composed of a material that when humidity is high creates another "battery" between it and the battery holder terminals. This condition has been known for many, many years as a "dissimilar metals" situation. It permits corrosion during circuit inactivity.

On the electrovoltage scale, these two materials have a large voltage differential. The word large does not mean hundreds of volts, but may involve less than one volt. However, this is sufficient to create the battery effect. This condition can exist between any two metals which are in intimate contact.

This topic is covered in the military standards, which we utilize in the design of military equipment. It is very important since military equipment must sit inactive for years, and suddenly be put into service, as in the Gulf War.

An easy fix is possible. I purchased from the hobby shop a tube of grease called "Electrically Conductive Grease," which is designed to be applied to the contacts on hand controllers. This grease reduces wear and also prevents corrosion of the wires during periods of inactivity. I applied the grease to the ends of the battery and to both ends of the battery holder. The problem is no longer a problem. Keep in mind that the grease should be unaffected by temperature, otherwise melting will occur and will wick into the rest of the unit.

Automotive terminals connected to the battery often corroded because of electrolyte leakage, and we prevented it by applying chassis grease to the terminals before attachment to the battery. Sealed batteries no longer require this simple fix.

Grease, like gasoline, is non-conductive. It is the ability of grease to prevent water vapor penetration that prevents the corrosion activity, and the firm tightening of the joint that permits current flow. Hope this is a help in understanding the corrosive terminal problem.

E.C.R., Jr.
Alton, IL

Well, it seems we are getting quite different explanations for the anomalous effects of Duracell batteries noted by J.S. At this point it appears that the best solution is to forward these letters to the manufacturer, and get their best engineering explanation. We will keep you informed!—Editor

ID-BLOCKER DESIGN

I recently came across a so-called "bullet" terminator or ID-blocker, which is supposed to guarantee cable privacy by allowing cable TV signals down the coax line but prevent any return signal going back up the line. Essentially it shields your equipment from monitoring by the cable company. The device, which doesn't require any power, is light-weight and small—only about 1-$^1/_2$ inches all around (L × W × D) and comes with input/output F-connectors. I would like to know how this little device can work. Since the rectangular enclosure is all one piece, I am afraid if I open it up I will ruin its performance. I don't think it is simply a filter, as how would it prevent the return signal? Got any suggestions before I tear apart the unit?

T.B.
via e-mail

One passive device that has these properties is known as an isolator. Usually an isolator contains a ferrite material that has electrical properties that allow RF energy to pass through in one direction with very little loss, but absorbs RF power in the other direction. Coaxial isolators always found wide usage in microwave applications (above 2000 MHz), but are now appearing in cellular products (around 900 MHz). For use in the frequencies allotted to cable TV (VHF/UHF bands), these products might get quite large and heavy for proper performance—so we don't believe that's what is in your device. Any readers got any clues on this one before T. B. cannibalizes his unit?—Editor

WHITE'S RADIO LOG

There was a publication called "White's Radio Log," which had all the AM and FM stations in the U.S. Do you know if it still exists or if the equivalent is published?

G.L.
Palm Coast, FL

Unfortunately, we have not seen this index since it was published as part of Communications World *magazine back in the mid-70s. We do know that various shortwave books list all sorts of shortwave frequencies, which include AM and FM stations, but we are not aware of any publications that lists the "standard" 550–1600 kHz, 88-108 MHz U.S./Canadian AM and FM bands, respectively. Perhaps some of our readers may be able to help you out.—Editor*

HAVES & NEEDS

I am in need of a service manual and a wiring diagram for an Eico #460 oscilloscope (transistorized model). The scope uses a CRT 5229P1B tube. I would be pleased to pay for copying and mailing costs.

Ed Litke
4318 53rd
Camrose, Alberta
T4V 4G3 Canada

I need a schematic diagram for a Micronta (RadioShack) V.O.M., Model 22-205. It must be this exact model number. It uses a 15-volt battery on the high-ohms range. Thank you very much.

Erwin Stanley
11358 Highway 67
Benton, AR 72015 ■

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TECHNOLOGY UPDATE

Amazing ergy bar provi ug wer

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A good start. These days, cars have complex electrical systems which support many accessories. Many of these features operate even if your car isn't running, which increases the risk that someday you'll find your car's battery drained...no horn, no lights, not even a click from the solenoid. Before Auto Starter, you either had to call a tow truck or try to get a jump from another vehicle. Tow trucks are slow to arrive and very expensive. Jumper cables, even heavy-duty ones, are dangerous and involve getting under the hood. Plus, there has to be another car around to provide the jump. Battery acid can burn your skin and ruin your clothes. If the cables are not connected correctly they can damage your car's expensive electrical system or, even worse, cause an explosion. With Auto Starter, you don't need a jump—you don't even have to open the hood. You simply plug the unit into the cigarette lighter, wait a few minutes and you're on your way. Leave the unit plugged in for 30-120 minutes while driving and it recharges automatically.

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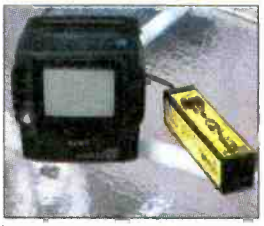
Auto Starter also makes it easier to work on your car. Plug it in before you change the car battery, and you won't have to reprogram your car's clock, radio or alarm system. You can even use it as an emergency alternator to run your car's engine for up to one hour. You wouldn't think of driving around without a spare tire—why not have a spare battery and alternator that fits right in your glove box?



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SCANNER SCENE

Mobile/Desktop *Relm* Scanners

Last year, *RELM Communications* introduced their HS Series portable scanners. RELM has now introduced its two long-awaited mobile/desktop models in the MS Series, the RELM *MS-180* and *MS-200*.

Both the MS-180 and MS-200 include coverage of the 800-MHz band, rapid scanning of up to 100 channels-per-second, priority scan, birdie lockout, and weather search. Features of the unit include an LCD-backlit display, direct-channel access, BNC antenna connector, a line out with audio, and an external speaker jack. There's also a memory lock to prevent accidental reprogramming or frequency deletion.

There are differences between the two units, however. *The* MS-180 holds 100 memory channels in 10 banks. The MS-200 also comes with 10 banks, but holds twice as many (200) memory

The Relm MS-180, which holds 100 memory channels, covers the 800-MHz band.

channels. Both units cover the VHF low/high bands, VHF aeronautical band, UHF/UHF-T bands, and the 800-MHz band (minus the cellular bands). The MS-200 boasts PL/CTCSS and DPL/DCS decoding as well as a severe-weather-alert alarm feature. In addition, an advanced
of up to eight
simple custom-
via optional PC pro

Both units come
AC adapter, DC powe
antenna, and mobile m
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Communications, 7505
Drive, West Melbourne,
Their phone number is 407-

FEAR OF TRUNKS

We have run several ann
ments regarding new scanners
offer the ability to track commu
tions on 800-MHz multi-channel tru
ed Motorola radio systems. It seem
that an ever-increasing number of larg
er municipal and county governments
are selecting trunked systems as they
expand or upgrade. As anyone who
has attempted to monitor a trunked
system on a standard scanner knows,
it's virtually impossible to follow a spe-
cific exchange of communications.

Trunked system communications are unique because they randomly shift to any one of a dozen or more frequencies with each release of the microphone button. Meanwhile, the system's other frequencies contain jumbled snippets of the conversations of those also using the same system. Hence the development of specialized scanners that can not only receive standard communications, but are also able to capture the desired communication you wish to hear on a trunked system, then follow it from frequency-to-frequency until its completion. *Uniden* has a handheld unit (*BC235XLT*) as well as a desktop model (*BC895XLT*), while *RadioShack* offers a handheld (*PRO-90*) unit designed to monitor standard systems as well as Motorola (the most commonly encountered) trunked systems.

Yet, we continue to receive mail from hobbyists who fear that trunked systems are, indeed, a bad omen heralding a dismal future for all of us, with slim pickings for the average listener. They see trunking as a sinister anti-monitoring move by public safety

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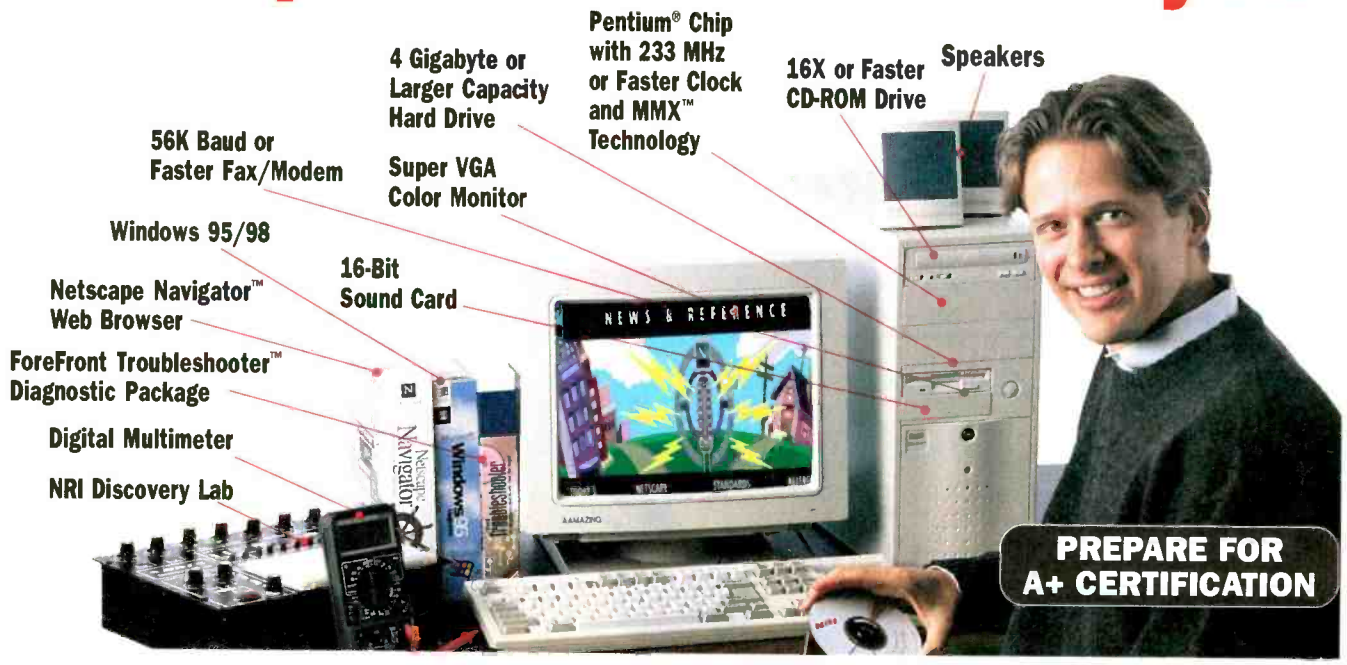

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agencies intended to obsolete the millions of scanners now in the hands of the public. I disagree!

Those governments and agencies that have opted for trunked systems have done so primarily because trunking offers them a way of expanding their systems to achieve the most efficient possible usage of the number of frequencies available. Those who wish to monitor are easily able to do so with reasonably priced, commercially available scanners that are simple to operate.

After closer examination of the facts, trunking looks to actually be a boon to the hobby! Certainly it has made things more interesting in my own area. In the old VHF system, each police precinct had a dispatch channel, the detectives had a channel, then there was a county-wide channel, and a car-to-car channel, plus a data channel for plate checks.

My local 14-channel trunked system offers ever so much more! Each precinct in my area now has two channels; there are two county-wide channels; two data channels; two tactical channels; ten surveillance channels; a main detective channel, plus specialized channels for robbery, homicide, intelligence, internal affairs and other detective squads; as well as a radio-repair tech channel; and several car-to-car channels. The system is also used by the medical examiner, sheriff (two channels), district attorney (two channels), state and county park police, probation officers, and others. In other words, in just this one system, there's a lot more now to monitor than there ever had been previously. So far as I am concerned, trunking has made scanning much more interesting when it comes to my own area's public safety agencies. To those who have viewed trunking as the beginning of the end, I'd suggest thinking about it as a new beginning and hoping that it comes to your area as soon as possible!

WEB SCANNING

If you have access to an online computer service, it's apparently possible to listen to any District of Columbia frequency via Realaudio, so reports Randy W., of Shamokin, PA. He advises you can click on a box to listen to hams, or weather, or the airport, or enter any frequency and mode of your own choice (FM Narrow-band, FM Wide-band, AM, or USB) to monitor specific police, fire, federal, or other activities. The website URL is: *http://speed.nimh.gov/listener/ralistener.html.*

CLUB STUFF

We were sorry to learn that The Scanner Club (of New Jersey) has recently ceased operation. It was a good effort but apparently couldn't garner sufficient member support to sustain itself. A real shame.

The Radio Monitors of Maryland continues strong and has been putting out an excellent monthly newsletter for several years. For more information, write them at P.O. Box 394, Hampstead, MD 21074-0394. Their e-mail address is RBscan@aol.com.

Scanning USA has had some good looking monthly issues containing frequencies, reviews, and commentary. Their address is 2054 Hawthorne, Joliet, IL 60435; Tel. 800-651-0922; E-mail: scanusa@compuserve.com.

We invite your opinions on trunking, your loggings, frequencies, and information relating to scanning, also column ideas. Our mail address is: *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735 or E-mail: sigintt @aol.com. See you next month! ■

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Circuits Galore

ALEX BIE

In our last column we discussed the point-contact diode, which is widely used both with integrated circuits and also as a discrete device for more conventional circuits. In this issue, we examine a similar component, but used in different applications, namely, the Schottky diode.

WHAT IS A SCHOTTKY DIODE?

The Schottky diode, or Schottky barrier diode, is an important device which is widely used in radio-frequency (RF) applications. Sometimes called the surface-barrier or hot-carrier diode, the Schottky diode possesses many similarities to the point-contact diode. In fact many of the early devices were made in the same way as a point-contact diode, although today's devices are made with totally different manufacturing techniques.

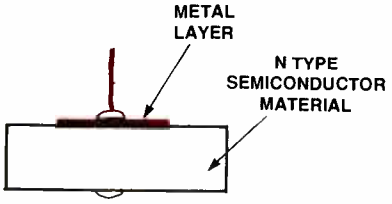

Fig. 1. Basic construction of a Schottky diode.

Unlike conventional semiconductor diodes, which consist of a PN junction, the Schottky diode is made from a metal semiconductor junction. This offers a number of advantages in some circumstances as the diode has a very low forward-voltage drop, and secondly it has a very fast switching speed. Both of these properties make them ideal for many RF applications as well as giving them uses in many other areas of electronics, as we shall see.

Simple Construction

In comparison with many of today's semiconductor devices, the Schottky diode is very simple in its construction. In its most basic form, a metal layer is simply deposited onto the semiconductor, as shown in Fig. 1. On some diodes, as shown in Fig. 2, a protective oxide layer is deposited onto the silicon around the area for the metallization. This "guard ring" is often used to avoid problems with leakage and breakdown effects associated with high electric fields.

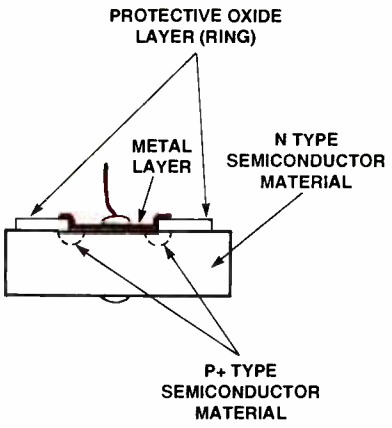

Fig. 2. Construction of a Schottky diode with an oxide guard ring.

Characteristics

The Schottky diode is what is called a majority carrier device. This gives it tremendous advantages in terms of speed, because it does not rely on holes or electrons recombining when they enter the opposite type of region, as in the case of a conventional diode. By making the devices small, the normal RC (resistance-capacitance) type time constants can be reduced, making the Schottky diode an order of magnitude faster than the conventional PN diodes. This factor is the prime reason why they are so popular in RF applications.

The Schottky diode also has a much higher current density than an ordinary PN junction. This means that forward-voltage drops are lower, making these diodes ideal for use in power-rectification applications. The main drawback of the diode is found in the level of its reverse current, which is relatively high. For many uses this may not be a problem. but it is a factor which is worth watching when using Schottky diodes in more exacting applications.

Variety of Applications

The Schottky diode is used in a wide variety of applications. It can naturally be used as a general-purpose rectifier. However, in terms of RF applications, it is particularly useful because of its high switching speed and high-frequency capability. As a result, high-performance diode ring mixers (shown in Fig. 3) almost exclusively use Schottky diodes to enable their performance requirements to be met. They

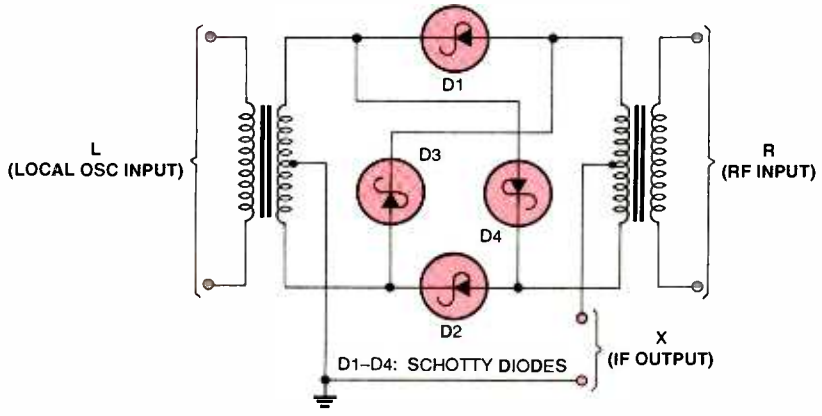

Fig. 3. A diode ring mixer.

("What is A...?" series by Ian Poole, G3YWX, reprinted by permission from *Practical Wireless*, Arrowsmith Court, Station Approach, Broadstone, Dorset BH18 8PW, England.)

are similarly very good as RF detectors as their low capacitance and forward-voltage drop enable them to detect signals which an ordinary PN junction would not see.

It has already been mentioned that the Schottky diode has a high-current density and low forward-voltage drop. As a result, Schottky diodes are widely used in power supplies. By using these diodes, less power is wasted, making the supply more efficient. Also this increase in efficiency means that less heat has to be dissipated, and smaller heatsinks may be able to be incorporated in the design.

The Schottky diode is used in logic circuits. Although not as common these days, the 74LS (low-power Schottky) and 74S (Schottky) families of logic circuits use Schottky diodes as a core component. The Schottky is inserted between the collector and base of the driver transistor to act as a clamp (see Fig. 4). To produce a low or logic '0' output the transistor is driven hard on, and in this situation the base-collector junction of the diode is forward biased. When the Schottky diode is present, this takes most of the current and allows the turn-off time of the transistor to be greatly reduced, thereby improving the speed of the circuit.

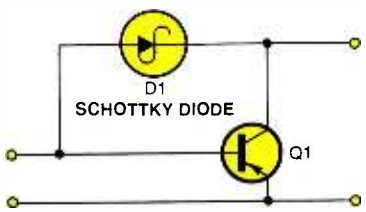

Fig. 4. Schottky clamp diode used for improved switching speed.

The Schottky diode is also used as a fundamental building block in a number of other devices from photodiodes to metal-semiconductor field-effect transistors (MESFETs). Not only does this diode find widespread use in many applications in its own right, but it is an essential part of many other components as well.

Next month, we will continue our "What is a ...?" series with voltage-reference diodes. Now let's look at some of those interesting circuits that our readers have sent in.

AM RADIO THEREMIN

A Theremin is an unusual musical instrument that is played without touching or contact; merely waving your hand near an antenna changes the audio from silence to a low growl to very high-pitched warble. The instrument is frequently associated with weird sound effects in spooky movies, but a few pros can do amazing things with the Theremin. Theremin designs can get awfully complex; but the one in Fig. 5 is very simple because we use a standard AM radio to handle all of the mixing, detecting, and audio amplifying chores.

In operation, Q1 and Q2 are the heart of two separate Colpitts oscillators, generating clean sinewaves at 1.1 MHz. Transistor Q1 is the variable, and Q2 is the reference oscillator. When Q2's frequency is tuned, via the 7–25 pF trimmer, to exactly match Q1's frequency, the difference or beat frequency is zero, and silence results in an AM radio placed in close proximity to this circuit and tuned to 1.1 MHz, or 1100 kHz. As your hand approaches the antenna, however, the capacitance at Q1 increases a few picofarads, lowering the frequency, producing a definite difference/beat frequency, which the AM radio makes audible. Should you live in an area having a radio station operating on 1100 kHz, then select a clear frequency for circuit operation as close as possible to this design frequency.

The circuit is simple enough to be breadboarded, but will be more stable when everything's soldered down. The 100-μH inductors are from *Radio-Shack's* inductor assortment (273-1601), and any standard ceramic trimmer in the specified 7–25 pF tuning range should work. For the antenna, use an 8-inch piece of bare or insulated solid hookup wire, straightened out. For much greater sensitivity, use a metal sphere like a toilet tank float. Try to get NPO capacitors in the circuit if possible for better stability, and for best performance put a metal sheet under the breadboard/circuit board and circuit-ground it; this allows the two oscillators to decouple at the lowest possible difference frequency.

—*Nick Cinquino, Schaumburg, IL*

I can see someone having lots of fun with this circuit, Nick—especially setting it up in a dark living room and waiting for an unsuspecting person to enter. On a serious note, there have been many interesting books written on the musical aspects of the Theremin instrument. A comprehensive Theremin Web site with many links is found at www.nashville.net~theremin.

A TRUE COTS

Commonly known as a capacity-operated touch switch (COTS), this gadget has many practical applications. Amateurs, for instance, can put the sensing plate near the mike and use the touch switch as a transmit/receive switch. Install the switch's sensing plate at the front door, and you have a light-touch doorbell button. Put the sensing plate near the top of a tank or tub, and when the water level gets too high, a bell will ring.

You have an option when building the touch switch. This design includes a flip-flop (built around a 4011 quad 2-input NAND gate IC) to keep, say, a light or bell on after you remove your finger from the sensing plate. To turn the light or bell off, you touch the sensing plate

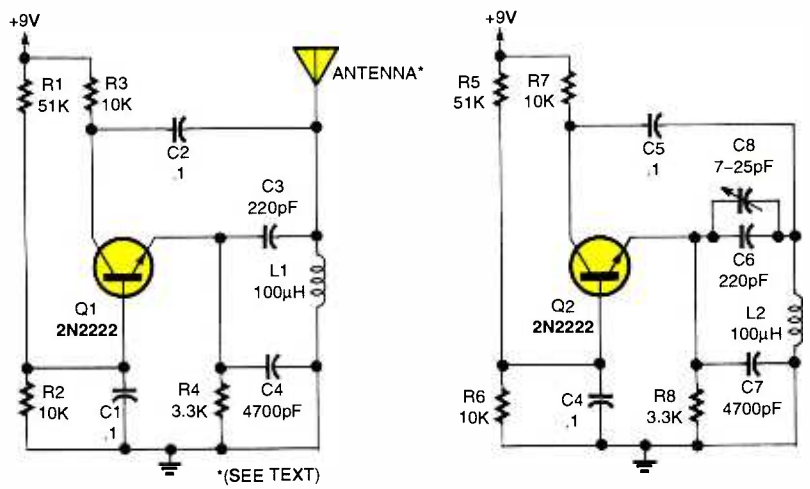

Fig. 5. Build this design for a Theremin musical instrument and listen to the weird sound effects.

a second time. If you are going to use the switch for a doorbell or a water-level alarm, eliminate the flip-flop. The doorbell then will stop ringing the instant you remove your finger from the sensing plate.

The circuit in Fig. 6 works like this: RF produced by the Q1 oscillator is coupled to the two secondary windings of choke L2. If the capacitances to ground at jack J1 and C6 are equal, voltage across the diode bridge (D1–D4) and Q2's base is at zero volts. When an antenna or sensor plugged into J1 is touched, the bridge is unbalanced and its output forward biases Q2, causing it to conduct and energize relay RY1, which drives the 4011 IC (flip-flop circuit) to control an output level.

Coil L2 is a modified 3-section 2.5-millihenry RF choke (use a *J.W. Miller* 6302, or *National* R-50, or equivalent choke). The modification illustrated in the figure inset, converts the choke into a transformer in which the center section becomes the primary and serves as the inductance in the RF oscillator circuit. Break the wire between the sections and unwind a few turns from each section. Wires from the left and right choke sections are connected together. I have identified each wire with letters A through F and show circuit destinations. The two outer sections become the secondaries of the transformer, which couple the RF from the oscillator to the four-diode bridge.

All resistors are standard $^1/_4$-watt, 10% units, and the capacitors are rated at 50 volts, unless otherwise noted. The power transformer, T1, is a UTC-type FT-13 with a 26-volt, 0.04-amp secondary. Relay RY1 is a SPDT-type with a 2500-ohm coil.

The first thing to do in checking out the project is to determine if the RF oscillator is working. Plug in the touch switch, and tune in an AM broadcast radio placed near the antenna, to around 800 kHz. If the oscillator is working, you'll hear it (the radio will go silent). The frequency is not critical as long as you pick it up somewhere in the broadcast band. If you are not going to mount the switch in a metal box, plug a 3-foot wire with a 1-inch diameter plate on one end, into J1. (If you are going to mount the switch in a metal box, hold off making the following adjustment until the board is installed in the box.) Connect a meter, set to a low DC range, across test points TP1 and TP2. Using a plastic alignment tool, adjust capacitor C6 for the lowest voltage on the meter. Use temperature-compensating capacitors for C3 and C4 and 5% resistors for R6 and R7. Remember to keep wires from L2 to D1–D4 and other parts as short as possible. For convenience, mount capacitor C6 so it can be adjusted through a hole in the cabinet.

—Craig Kendrick Sellen, Waymart, PA

Nice going, Craig. I am sure our industrious readers will find many applications for this circuit. You can substitute an NTE123AP or SK3854 for the 2N3904 transistors and an NTE4011B or SK4011B for the 4011 quad 2-input NAND gate IC.

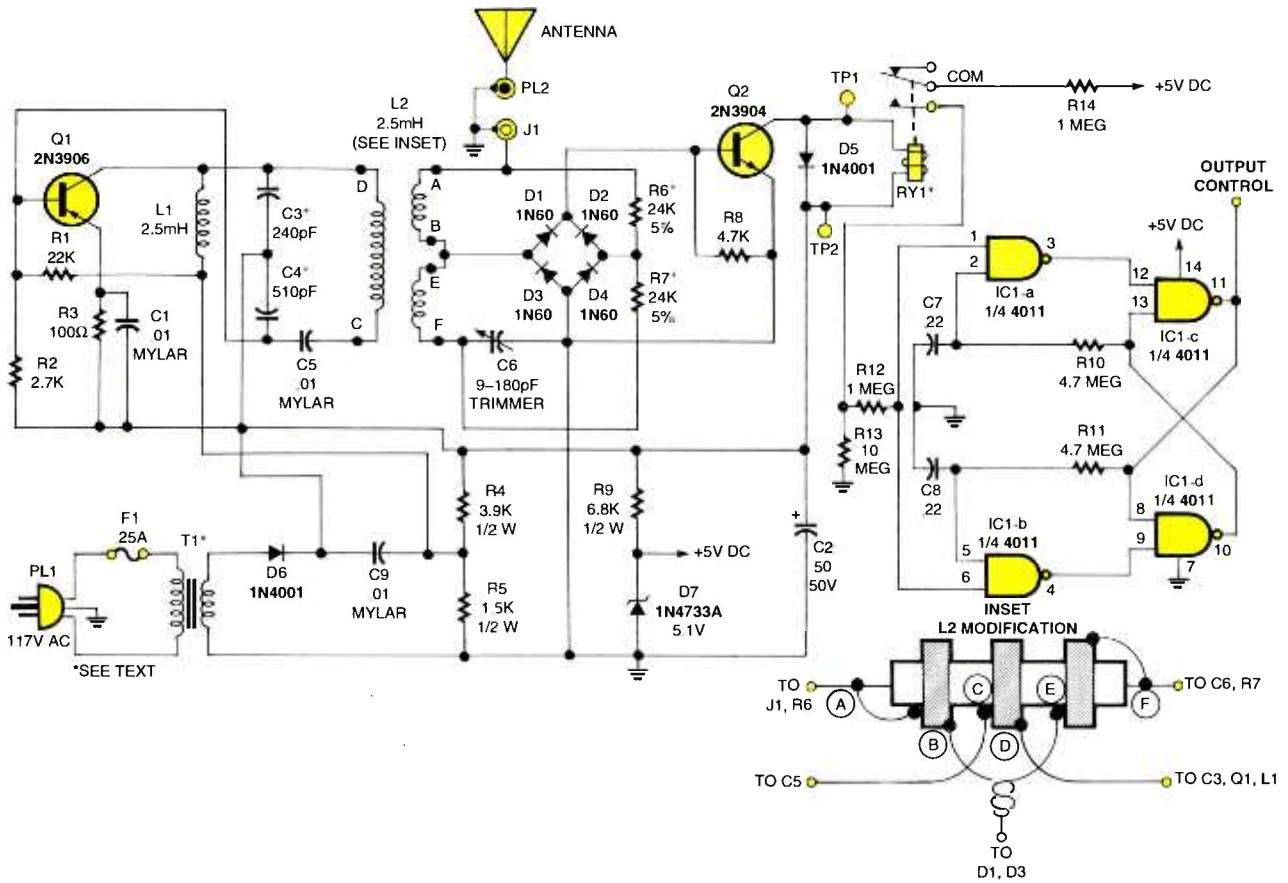

Fig. 6. The overall schematic for the carrier-operated touch switch (COTS) is shown, while the inset illustrates the modification of choke L2. This coil must be altered by breaking wires between the sections, unwinding them, and soldering the wires from the left and right windings together (points B and E).

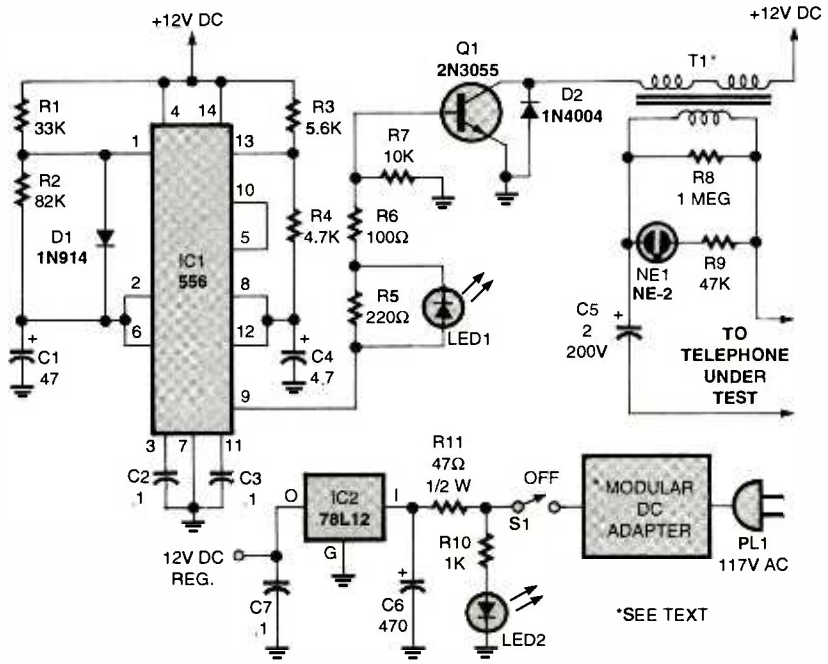

Fig. 7. Got some old telephones around? Build this telephone-ringing generator and buzz out those old phones.

TELEPHONE-RINGING GENERATOR

I had accumulated several phones—some of which I did not know would ring when called. What was needed was a test that wouldn't involve someone else calling in to check each set. The circuit shown in Fig. 7 was constructed and tested on several phones. I used a ratio of 1-second on with 3-seconds off, which outputs a 20-Hz ring of sufficient power to ring up a standard phone.

The heart of the timing circuit involves a 556 dual timer. Two 555 timers also will work. I used a transformer to step up the pulses with enough power to ring "the bells"! These are components from my junkbox. Other parts may work as well. Please use the component values shown for the timer, as this sets the correct timing sequence. All resistors are $^1/_4$-watt units and all capacitors are rated at 50 volts, unless otherwise indicated in the figure.

This circuit draws about 0.9 amps from a 15-volt DC type modular wall supply. (The one I used was from *Hosfelt Electronics*; Tel. 800-524-6464 or 888-264-6464; part number 56-528.) Don't try to get along with less power. Be sure to mount the 2N3055 power transistor (Q1) on a heatsink. I've left this generator on for an hour with no problem, although the transformer does get quite warm to the touch.

The transformer I used was a Magnetek Triad F-131P (*Allied Electronics*; Tel. 800-433-5700; part number 967-1071) with a 120-volt primary to dual secondary rated at 8-volts CT at 188-mA series-connected secondary. An NE-2 neon lamp is a visual indicator of power out to the phone line. LED1 at the output of the timer (IC1 pin9) shows drive to the output transistor. In setting up the timing, the output from IC1 at pin 5 should be a 1-second on, 3-second off pulse train, while the pin 9 output is similar, but with 20-Hz (0.05 ms) pulses generating the 1-second on-time signal.

One word of caution: **DO NOT plug this unit into a hot telephone line!** Also be sure to use a non-electrolytic capacitor from the transformer output to the phone jack. I hope this project will be useful to others that would like to check out some telephones to see if they ring when called.

—Roger W. Hamel, Cedarville, MI

Very useful circuit, Roger. For the 556 dual timer IC, you can substitute an NTE978 or SK3689; for the 2N3055 NPN transistor, you can use an NTE 130 or SK3027 transistor, and an NTE950 can be substituted for the 12-volt regulator of IC2.

MAILBAG, ETC.

I'm always extremely pleased to see somebody actually get some practical use out of one of my designs! I refer, of course, to the "Home-Brew Zener" by Craig Fawcett/CET of Downers Grove, IL, (December 1997, *Think Tank*). By substituting a TIP120 power Darlington for my original 2N6427 small-signal Darlington as Q2, Craig has attained high-voltage/high-power performance with this simple circuit. My design was a result of a need for a high-performance, low-voltage Zener.

My original circuit "Zener Diode Simulator" (see March 1996, *Think Tank*, page 68) was based on what is called a "V_{BE} Multiplier" effect, which uses the base-to-emitter voltage drop (0.6 volts) of Q1 as a reference. This reference generates a constant current in R1, and also R2 and R3. By changing the series resistance of R2 and R3, the voltage drop across them is varied and added to Q1's V_{BE}. Unfortunately the temperature coefficient of Q1's V_{BE} is about −2mV/°C, and is also "multiplied" by the resistor string at about 6 volts (10 × 0.6 volts). For example, temperature drift would be about −20mV/°C—not too good for a regulator! This is why I included D1, a 1N34 germanium diode, in series with R1. As D1's temperature coefficient is similar to Q1's, and its forward voltage drop is about $^1/_2$ of Q1's, it almost exactly compensates for drift of the constant current through R1, R2, and R3. Transistor Q2 was added to the V_{BE} multiplier to handle the load current without affecting Q1's biasing level.

—Skip Campisi, S. Bound Brook, NJ

In the circuit shown in April's column, for the project "Visible Auto-Battery Voltmeter," page 55, I believe that the component values for R1 and R2 are reversed. Potentiometer R1 should be 5k ohms, while R2 should be 1.2k ohms.

—Mike Leese, Southfield, MI

You are absolutely correct, Mike. Just a reminder, any errors uncovered in this column, verified and corrected are immediately put out on our Web site, www.gernsback.com, *in the Forums link.*

Well, that's about it for now. Readers this is **your** column—send those novel circuits, ideas, and comments my way. Write me—Alex Bie, *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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Video killed the radio star? No. Though no longer the dominant news and information medium that it once was, radio is still very strong. But radio manufacturers seem determined, for reasons that we can't figure out, to kill radio by making receivers that just don't deliver the performance that radio is capable of delivering. Stereo receivers and tuners today rarely approach the capabilities of those that were made in the 1970s and earlier. Take your average table radio or portable, and things just get worse. It seems outrageous that, with all of the improvements in electronics technology in the last 20 years, radio's state of the art should actually get worse.

That's why it was so refreshing to give the *GE Superadio III* a try. From the outside, the Superadio looks like your average, ordinary Clark Kent model. It measures about 12-½ inches wide, about 8-¾ inches high, and 3-½ inches deep. A slide-rule dial spans the top of the front panel. Most of the rest of the front panel is occupied by the speaker grille, which covers two drivers: a 6-½ inch woofer and 2-inch tweeter. To the right of the speaker grille is a set of three rotary controls (VOLUME, BASS, and TREBLE) and three slide switches: AFC, BAND (AM/FM), and a WIDE/NORMAL selector. The tuning knob and a headphone jack are on the right side panel, and the POWER pushbutton and FM whip antenna are on the top. The rear panel has a battery compartment along the bottom and screw terminals for connection to external AM and FM antennas.

In general, the radio doesn't seem like anything special from its looks. But looks can be deceiving. Take the external antenna connections, for instance. They *shouldn't* be considered something extraordinary, but how many table radios or portables have you seen with *any* antenna inputs—and AM no less? That was the first indication that the Superadio III was built with some thought given to its reception performance. Embossed on the rear panel are the words "200 mm AM ferrite rod antenna." A radio bragging about something as sexy as its built-in antenna? We've never seen that before. (Incidentally, we did not attach external antennas to the Superadio during our tests because an antenna can often have a bigger impact on reception than the receiver it's attached to, and we wanted to evaluate the radio's basic performance.)

The second indication we had that some thought went into the radio's performance was the presence of its WIDE/NORMAL switch. This switch, which works only for the AM band, changes the receiver bandwidth. We figured that it could potentially be used to reduce adjacent-channel interference by selecting a narrow bandwidth. In practice, however, we found the wide position to be virtually useless. Arguably, it could increase the fidelity of local stations by increasing the radio's bandwidth. But we used the NORMAL (narrow) position almost exclusively. The wide setting made it virtually impossible to tune in any stations between the locals. We would have preferred to have both settings a

little bit narrower.

Flipping through the "Use and Care Guide" supplied with the Superadio gave us yet another hint that the receiver was something special. "High-performance, long-range AM/FM portable radio" it's called on the front cover. "DX helpful hints" reads one of the section headings. It give three pointers. The first suggests that "although the built-in AM antenna will enable you to receive many distant stations, your reception can be improved significantly with the addition of an external AM antenna." The second says that long-distance AM reception is better at night, and the third notes that winter is better than summer because there are fewer thunderstorms. All three points are true, of course, but rarely acknowledged in consumer radios. Finally, the "Personal Station Log" in the manual, accompanied by the suggestion that "you may enjoy keeping track of distant stations you receive" made us ready to ask just how good this rather normal-looking radio is.

A couple of other things in the manual impressed us. First is a mention that service literature is available—a service manual available to consumers for a reasonable price. That's virtually unheard of today. Second is the note that "the whip antenna has been designed so that it is easily replaced in the event it is damaged." There's even an order form in the manual ($9.10 plus $5 shipping, handling, and insurance). Seems sort of sensible, no?

The Superadio can be powered from the AC lines or by six D cells. We used battery power almost exclusively during our evaluation. We didn't find that we had any increased interference using AC; it's just that we liked the convenience of being able to carry the radio around to different listening locations. The power cord is permanently attached to the radio, but it tucks inside the battery compartment when it's not in use so that you'll never find yourself without it. When plugged into an AC outlet, the radio automatically switches from battery power to the AC line.

So from the outside, the Superadio seems to be designed sensibly, with the emphasis on reception capability. But how does it perform in real life? To find out, we put it to work at our listening location on Long Island, New York, about thrifty-five miles east of Manhattan. With most radios, daytime AM reception is limited to stations on the Island, those in New York City, and a handful in Connecticut and New Jersey. The Superadio received all of those normal stations just fine, and its speaker system made AM radio sound about as good as it can. But the Superadio also delivered far more stations than we're used to getting in the daytime. We picked up several Philadelphia stations (including WIP, WPEN, WFIL, WZZT, and WPHT), some New Jersey stations (including WTMR), and stations from Connecticut, Rhode Island, and Massachusetts (including WELI, WRKO, WSUV, WLKW, and WBZ).

Not all of the stations mentioned above were received with perfect fidelity, but they were all definitely listenable. With the football playoffs getting closer (as we tested this radio) I was happy to listen to the play-by-play of the Philadelphia Eagles' game against the Detroit Lions. Occasional fading wasn't too much of a hindrance.

We were impressed by the radio's ability to receive, about an hour before sunset, three stations on 800 kHz: WTMR (Camden, NJ), WLAD (Danbury, CT), and CKLW (Windsor, Ontario). This was a good demonstration of the built-in loopstick antenna's directionality—we could select the station we wanted to hear by rotating the radio to the proper direction. A little bit further up the dial, we received CHML (Windsor, Ontario) and KDKA (Pittsburgh, PA), two other stations we would not normally expect to hear at 3:30 in the afternoon.

After sunset, we went back to the radio. We could receive the stations that we would expect a decent radio to pick up. WTAM, the 50,000-watt powerhouse from Cleveland, came in just fine. We could listen to WBAL from Baltimore, WLS in Chicago, and WHAS in Louisville, KY. None of those is very surprising. Not every radio has the selectivity and sensitivity to receive them on Long Island, but we could consider any that can't to be poor, indeed. The difference with the Superadio is that it could receive those stations regularly and reliably. Plus, it could receive, without much effort, WWL from New Orleans and WHO from Des Moines. We've logged those stations before, but rarely without an external antenna and a high priced receiver—just a lot of luck.

FM performance was equally impressive. We could basically receive the same stations that we do using an external antenna with our stereo FM receiver. The complaint here, again, was with the tuning dial's accuracy. Of course, the radio does not receive stereo. It can, however, be used with a set of stereo headphones, a decided convenience.

The black, plastic radio is hefty. When loaded with six D batteries, it weighs close to ten pounds. Despite this heft, the radio does have a feeling of cheapness to it—the flimsy plastic knobs don't inspire confidence in the receiver's capability. The slide-rule dial is, unfortunately, inaccurate, and above 1000 kHz, tuning can be somewhat difficult because of the close spacing on the dial. Perhaps we're just forgetting the days before digital tuning became the norm.

Missing from the Superadio III is a dial light, which would be a useful feature. We'd also like to see a different power switch, perhaps a slide switch instead of the top-mounted pushbutton that seemed too easy to push accidentally.

Those complaints aside, we should note that we've been listening to radio and DX-ing for about three decades, and we've used a wide variety of receivers ranging from pocket transistor radios to component stereo equipment to expensive communications receivers. But we've never come across a radio quite like the Superadio III. When propagation conditions are good, almost any radio can receive stations from hundreds of miles away. But we found that the Superadio receives DX more consistently and with better fidelity than most other radios. The Superadio III's AM performance compares favorably with communications receivers costing ten times as much or more.

In short, the Superadio is aptly named. And its price is more than reasonable—even if you pay full list. We wonder, though, why the caliber of performance demonstrated by this inexpensive radio is so rare. The technology used certainly isn't new. And if Thomson can make a $60 radio that performs like the Superadio, shouldn't all AM/FM radios be as good?

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Picture this: You and your significant other are sitting at a romantic bistro in Paris (or a cafe in Rome, a tapas bar in Madrid, a beer garden in Munich, a sushi bar in Tokyo). You're pleasantly tired after a day of seeing the sights, relaxing over drinks, and anticipating a delicious dinner, when you're confronted with an indecipherable menu and a waiter who doesn't speak a word of English. Time to pull out the pocket translator, and begin typing in line after line on that itsy-bitsy keyboard. Kind of breaks the mood, doesn't it?

Now picture this: Instead of an inconvenient pocket translator (or a printed bi-lingual dictionary), you pull out a handheld device that allows you to scan the words on the menu, displaying each one in turn. By passing the device over the menu, you can "read" the daily selections. Perhaps it won't impress your date as much as fluency in a foreign language would, but it does have a certain "wow" factor.

The device that you're picturing is *Seiko's Quicktionary*. The "scan and see" translator will soon be available in ten languages—Arabic, Dutch, French, German, Hebrew, Italian, Japanese, Korean, Russian, and Spanish—each translating to and from English. The French/English (which we tested) and Spanish/English models are currently selling.

The Quicktionary is about 6 inches long, 1-1/2 inches wide, and 1 inch deep, and weighs in at 3.2 ounces, without the three supplied "AAA" batteries installed. A hard-plastic protective case adds little to the weight or bulk of the unit. The top of the Quicktionary features a three-line by 20 character display that measures approximately 2-3/8 × 3/4 inches. To the left of the display are an array of arrow keys, used to scroll through the text, and two keys labeled ESC and ENT. A red POWER button completes the "front-panel" controls.

The scanning mechanism is found at the left end of the unit, shielded by a plastic cover. If you peer inside, you can see the "optical eye" mounted above the two red rollers that are used to glide the scanner over the text. Protruding in front of the rollers is a clear plastic shield with a black line down the middle, intended to help you correctly position the scanner over each word. When Quicktionary is ready to scan, a red light flashes, and the message "Ready to scan in French (or English)" appears on screen. As it scans, the red light remains steadily on; it goes off while the unit is interpreting the scanned image, and then flashes when it's ready to scan once again.

We decided not to tackle the manual right away, but to rely on the one-page Quick-Start directions to help us get acquainted with the Quicktionary. There are actually four pages of Quick-Start instructions—one each for English-speaking and French-speaking right- and left-handed users. The unit's ability to switch from right- to left-handed use is one of its more impressive features. Not only can you scan words from left to right or right to left, but when you select left-hand use from the on-screen menu, the display immediately flips upside down so that you can read it while holding the unit in your left hand, and the arrow keys reverse their directions to match the new screen orientation.

The directions appear to be simple and straightforward: Remove the cap, press the power button, place the rollers to the right of the word to be scanned, align the pointer with the center of the text, roll to scan, and lift it off the page. The scanned image will appear in the display, followed by the translation.

It's not as easy as it sounds, however, at least until you get the hang of it. It takes a while to learn just where to place and lift the rollers to get the complete word and only that word, and how to align the scanner so that it doesn't cut off the top or bottom of the letters. The angle at which you hold the Quicktionary also affects its ability to scan properly; it can't be held perpendicular to the paper or at too sharp an angle. We also found it a bit awkward to move the scanner from right to left (the opposite of the way we read), as suggested on the Quick-Start page for righties. (According to the full manual, however, it's okay to scan in either direction.)

Almost immediately, the scanned image shows up on the display. If you've positioned the Quicktionary correctly, you'll see the full word displayed. If not, you'll be able to see precisely what you did wrong—the beginning or end, or top or bottom, of the word will be cut off, or perhaps the word will slant right off the top of the screen. In any of those cases, you'll get a "no word found" response.

If you maneuver the device correctly, the full word will be displayed. In a few seconds, the image is replaced by a dictionary-style display of the word and its meanings (however, no pronunciation guide is provided). The most common definition is listed first, followed by variations, and, in some cases, a few common phrases that include the word.

Not having much French-language material around the house or office, we first tried using Quicktionary on the French version of the Quick-Start instructions. Because our high-school French is more than a little rusty (completely erased from memory is more like it), we were glad to have the English version on hand for ready comparison.

The French directions begin with: "Otez le capuchon." Otez was defined as "remove, take away, take off, divest oneself of, doff." "Capuchon" means hood or bonnet. Not quite a direct translation from the English version: "Remove the protective cap from the tip," but close enough to convey the general idea.

The next line—"To turn on Quicktionary, press the power button"—appeared as "Pour allumer le Quicktionary, appuyez sur Power." Here, we ran into some trouble. Pour was defined as "for, because of, on account of, toward, for the sake of, in order to, so as to," and allumer as

"light, kindle, let off, light up, set alight." Appuyez was defined as "support, back, back up, espouse, stand by, substantiate, establish, shore, shore up, hold up, sustain, uphold, bear out, corroborate." But after we finished scrolling through that list, the phrase "appuyez sur" appeared, followed by the definitions: "press, push, base on, ground on, found on, found upon." The word "Power" was not recognized at all, perhaps because it is an English word adopted for French use.

In any case, with the provided definitions, the closest we could get to the proper translation would be "In order to light up the Quicktionary, press Power." Not too bad—but we already knew the correct translation. Had we simply gone word for word with the most common definitions, we'd have come up with "For light the Quicktionary, support about Power."

We then decided to put Quicktionary to the dining-in-a-French-bistro test, using a book of menus from various restaurants in New York City and vicinity. Because many of the menus described the foods in both French and English, we were able to gauge the accuracy of the Quicktionary's translations.

We began by scanning the heading "Volailles et Viandes," which Quicktionary correctly translated as "fowl, poultry" and "meat." The first entry listed was "Poissin entier au parfum de truffes, petit farci de foie gras." (Its English description was "Roasted baby chicken, truffle sauce, foie gras savoury.") Quicktionary did quite well with the first two words ("chicken" and "complete, entire, whole"), and okay with the next few ("parfum" was translated as "flavor, taste, savor, smell...," "truffes" as "truffles," and "petit" as child, kid, small child, young, young one ..."). From those words, we could figure out that it was a whole baby chicken flavored with truffles. Quicktionary ran into trouble, however, with the rest of the description. The phrase "foie gras," which means goose liver, was not represented. "Fois" was defined as liver, and "gras" as "fat, greasy, fatty." Doesn't sound very appealing, does it?

The next entree, "Medaillon et ris de veau au porto, risotto au cresson," or "Medaillon and sweetbread of veal in port sauce, watercress risotto" also suffered in the translation. "Cresson" when scanned, was read as "tesson" and defined as piece of broken glass—something we'd prefer not to see in our risotto. "Ris" was defined as "laugh, laughter," which we certainly wouldn't have been doing if we'd expected simply medallions of veal and were also served sweetbreads (brains).

We probably would have had some good laughs at many of the translations. "Champignons sauvages" means "wild mushrooms," and "champignons" was correctly interpreted right away. The first few meanings listed for "sauvages," however, were "savage, brute, ruffian, and thug." Quicktionary misread the scanned word "rotisserie" as "rosserie," which means meanness or nastiness. This is a meal we wouldn't want to mess with!

At that point we were ready to delve deeper into the workings of Quicktionary, and opened the English-language section of the main user's manual. There we learned several interesting things. For instance, Quicktionary *does* translate phrases. You can use the cursor and enter button to define the parameters of a phrase and find the translation. Unfortunately, "foie gras" and "champignons sauvages" were not listed; nor was "fruits de mer," which we know means seafood.

On the plus side, Quicktionary had little trouble recognizing the scanned words, even though several of the menus were printed in fairly elaborate fonts. If we had come across an unscannable word (perhaps the daily specials were chalked on a blackboard, or we wanted to know what a sign in a store window meant), there are two other ways to enter it. Quicktionary comes with the "Opticard," a card sized to fit into the carrying case on which each letter of the alphabet is printed along with its corresponding bar code. First, you'd scan either "English to French" or "French to English" and then the individual letters. Actually, using the Opticard was often faster and more accurate than scanning a word. To scan the individual letters, you simply place the scanner on top of the letter until the red light dims—generally, less than a second. Then it's time to scan the next letter. When you're done, press ENTER, and the translation appears.

The second way to input words is to use the on-screen menu. Select "key in new word" and then use the cursors to scroll through the alphabet to find the first letter. Move the cursor over, scroll again, and so on, until the word is complete. Then press enter for the translation. We can't see why anyone would go through all that bother, unless he had forgotten to pack his Omnicard.

The on-screen menu offers several other options. It is used to select French-to-English or English-to-French translations, to see a "history" of the last 75 words translated, to adjust the contrast, to change the auto shut-off time, to check the batteries, to select the menu language, to choose right- or left-handed use, and to view adjacent entries.

Once we were a bit more familiar with the workings of Quicktionary, we turned to the Internet to find something written in French, and came up with a site called "Sail the World" or "Autour du monde en bateau." Sure enough, "autour" translated as "around," "monde" as "world," "en" as "in, at, with, by," and "bateau" as "boat." The only confusion was the phrase "du monde," listed under "monde," which meant "people, folk, folks." We chose to disregard that, since we knew the site was discussing sailing around the world.

The web page opened with a quotation, attributed to P. Chatel: "Faites que le reve devore votre vie, afin que la vie ne devore pas votre reve." Word by word, Quicktionary translated it as: "Act like that fondest wish destroys (or devours) your life, so that life does not destroy your fondest dream." We already knew, from those long-ago French classes, that "ne ... pas" surrounding a word makes that word negative ("does not destroy"). "Ne", alone, means born, however, and "pas" means "step, pace, move, footstep, walk, or threshold"—which could certainly change the whole meaning. At the very end of the listing for "pas," following several phrases describing different types of footsteps and gaits, came "ne ... pas, not."

That much translating took close to a half hour.

We also managed to "read" other paragraphs on the web page. Under the heading "Les nouveaux moyens de communications" (the new means of communications), it said something along the lines of "This study demon-

strates the means of communications real and to come," which we assume is a course description of modern and future communications systems. Something called "L'ecole du bout du monde"—direct translation, "the school of a little bit of world"—we guess meant "small world." It was described (loosely translated, once again) thus: "Discover this new column on how to make (do/form) school on board a boat benevolence of the Internet."

After "reading" the page, we're still not sure if the site offered actual classes on round-the-world sailing expeditions, or perhaps on-line magazine articles. We'd hate to rely on such spotty translations in any sort of business or legal dealings, however. We also can't imagine devoting that much time to reading anything at all.

Like all other electronic language translators we've tried, Quicktionary can't translate the nuances of language. It might be useful to get the meaning of an occasional unfamiliar word, especially if you can pick the right meaning by a sentence's context. It is decidedly a cool gizmo. But, if we ever do get to take a trip to Paris, we're bringing along a phrase book, and maybe enrolling in a Berlitz course beforehand.

EYES IN THE BACK OF YOUR CAR

ULTRASONIC REARVIEW BACK-UP ASSIST SYSTEM MODEL DE35BR. From Whistler Corporation, 16 Elizabeth Drive, Chelmsford, MA 01824; Tel. 508-244-1400. Price: $119.95.

It's been said that parents need eyes in the back of their heads to keep one step ahead of the trouble their kids get into. And, sure enough, parents develop that sixth sense that warns them to check on the kids playing a bit too quietly in the next room—they just might be coloring the walls instead of their coloring books, or actually eating the clay "cookies" they've been baking in their play kitchen.

Parents also know that kids mean clutter—outside as well as in. Children tend to drop things wherever they happen to finish using them—like leaving a bicycle in the driveway to pick up a game of basketball, then leaving the basketball on the ground when snack time rolls around. If your family includes such a driveway litterer, having eyes in the back of your head isn't enough. You also need eyes in the back of your car to avoid crunching your kids' discarded toys when you pull out of the driveway. Some would say they had it coming for neglecting their toys, but it would be a shame to back over a $200 mountain bike that you couldn't see out the rear window of your car.

Whistler's Ultrasonic Rearview Back-up Assist System actually allows your car to "see" what's behind it. The *Model DE35BR* detects objects or people within seven feet of your rear bumper when you're backing up, and warns you with audio and LED signals. Its real purpose is not so much to prolong the life of children's toys and paraphernalia, but to help you park in tight spaces, back up safely in poor visibility conditions, and avoid backing over people or pets. Granted, that doesn't happen often. But, tragically, it *does* happen—we've read newspaper accounts of a man backing over his wife, who was kneeling to pull weeds from the edge of the driveway, for example. It's not hard to imagine a child darting out behind a moving car whose driver just doesn't see him.

The Back-Up Assist is a two-piece system, complete with the necessary mounting hardware and wires. The control unit measures approximately $3\text{-}3/4 \times 2\text{-}3/8 \times 1$ inches (H×W×D). Its front panel features a speaker and four LEDs—a green power indicator and three red lights labeled 2 FT., 3.5 FT., and 7 FT. A three-position volume control slide switch is located on the left side of the unit. Two jacks are found on the bottom of the control box: one to connect the power cord, and the other to connect the sensor/detector unit.

The $3\text{-}1/2 \times 1\text{-}1/4 \times 1$-inch detector unit has two indented areas on its front face. One houses an ultrasonic emitter; the other, an ultrasonic sensor. The weather-resistant detector unit is intended to be mounted on the vehicle's rear bumper, with the emitter and sensor facing out. Whistler has included adhesive-backed Velcro fasteners as well as brackets with hardware for bolt-down installation. An 11-foot wire extends from the back of the detector. It's plenty long enough to reach the control box, which is intended to be mounted inside the vehicle, using another piece of adhesive-backed Velcro at the juncture of the right-rear and rear windows.

The Back-Up Assist system is powered by splicing the included power wire to the wires powering the vehicle's back-up lights, and that splicing is the only "difficult" part of the installation process. In most standard cars, the wiring is found in the trunk. In many vans and station wagons, it's right inside the car, further simplifying setup.

It's a good thing that installation is so easy, because the instructions are almost non-existent. Even so, we're so accustomed to mounting any auto-electronic controls on or near the dashboard that it took a couple of readings through the very short instructions to convince us that the Back-Up Assist control box really does belong on the right-rear corner of the car. As soon as we used it, however, we realized that that is the only logical place for it: When you back up,

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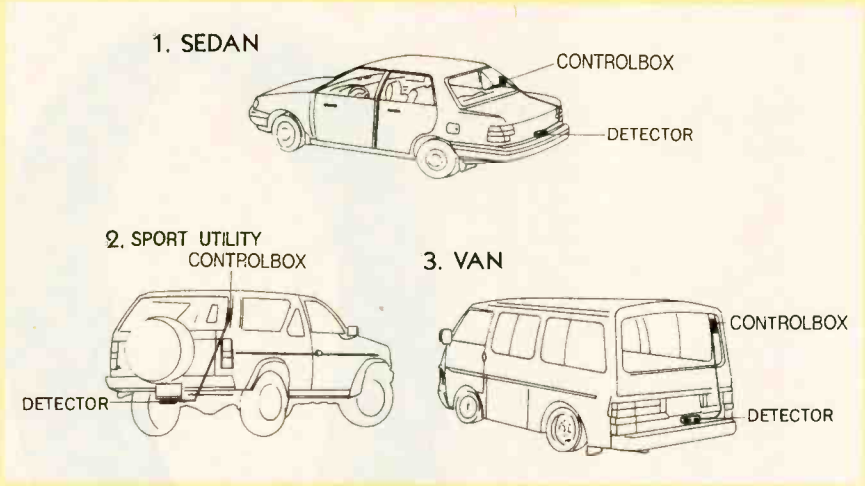


Fig. 1. The placement of the control box and detector vary slightly depending on the type of vehicle.

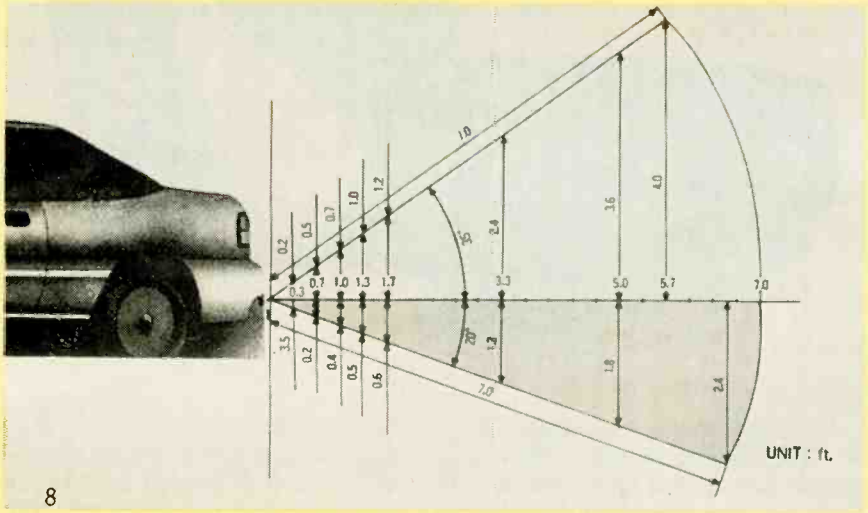


Fig. 2. A side view of the Rearview Back-Up Assist's vertical scanning angle.

you look over your right shoulder to see behind you.

With the Back-Up Assist installed, there's no need to give it any more thought than you do, say, your brake lights. The system powers up automatically whenever you shift into reverse and your backup lights are activated, and the green LED on the control unit lights up. As you approach an object, several different warnings are offered. When you get within the six-to-seven-foot range, the bottom red LED lights and a beeping sound begins. Keep backing up, and when you get to within three-and-a-half feet of the object, the middle LED also lights and the beeping turns into a chirping sound. Get within two feet, and the top red LED comes on just as the audible alarm changes again, this time to a lower-pitched beeping.

In our tests, we purposely backed up toward various objects, including a parked car, a pole-mounted basketball hoop, and a bicycle. In each case, we stopped the car and got out to eyeball the distance each time a different alarm sounded. Sure enough, the Back-Up Assist was right on the button. There were a couple of instances in which we were sure we were about to touch bumpers, even before the two-foot warning sounded. Each time, we still had those two feet to spare.

The Back-Up Assist would certainly come in handy when trying to parallel park a station wagon on a New York City street—especially when you don't have a buddy with you to get out and "wave you in" to the spot. It might not work quite as well when you're trying to maneuver your way out of that tight spot, however, because there's a "dead zone" in the detecting range that extends out from the detector about 12 inches. So if you're really sandwiched into a spot, the system won't warn you with lights or beeps.

In most instances, of course, you would be aware when you entered your car that another car (or large, permanent article such as a fence or a tree) was directly behind yours. That might not be the case, however, with a toy or bicycle carelessly left practically under the rear bumper.

In a more common scenario—backing up into the driveway with the rear of the station wagon piled high with groceries—the Rearview Back-up Assist was remarkably efficient at warning us that we were about to back over an unseen garbage can or bicycle. Ditto when backing out of the driveway toward a neighbor's car parked directly across the street, or when approaching a chain-link fence. We quickly became accustomed to the system, and found ourselves relying on it for a "second opinion" in some tight parking situations.

SUPER MARIO UNPLUGGED

NINTENDO MULTIMEDIA WIRELESS HEADPHONE SYSTEM MODEL NHP-W60. From Laral Group LLC, 500 Eastern Parkway, Farmingdale, NY 11735; Tel. 516-293-6900. Price: $59.99.

Gone are the days when whole families would gather around the living-room television set, enjoying the same program together. In today's typical after-dinner scenario, you're likely to find one family member watching TV, another listening to a CD, someone playing a video game, and yet another person working or playing on a PC. And when the computer and the home-entertainment center are both found in the family room, conflicts are bound to erupt.

Your family can go a long way toward achieving peaceful coexistence by equipping one or more members with headphones, allowing them to blast MTV or play an action game without drowning out anyone else's activities. *Laral Group's NHP-W60 Nintendo Multimedia Wireless Headphone System* has the distinction of being the first such product to carry the Nintendo brand name. Although it's aimed at gamers, it can also be

used for unencumbered listening up to 25 feet from any video or music source.

The system consists of an infrared transmitter, the headphones, a connecting cable equipped with both RCA and mini-plugs, and a power cord. The transmitter is a black plastic semicircular disc, measuring about 3-$^1/_2$ inches at its straight side and just over $^1/_2$-inch deep. The curved side holds the eight high-power infrared LEDs that transmit the signal to the headphones. The transmitter sits on a tilt base that can be adjusted to three different positions (up, horizontal, down). The back (straight) edge of the unit contains stereo audio-in jacks, a jack for the power adapter, and a power switch.

The headphones feature over-the-ear pads. The volume control is found at the bottom of the right ear piece, and the on/off switch is located on the left ear piece. There's a bullet-shaped, glossy black plastic piece emblazoned with the Nintendo logo extending from the adjustable headband down to each ear piece. The one on the right houses two infrared sensors to receive the signal from the transmitter. The one on the left covers the battery compartment. The headphones require two "AAA" batteries, not included.

Setup is simple. The connecting cord has a mini-plug at one end and color-coded (red and white) RCA plugs at the other. The transmitter has jacks for both. Setup depends on the outputs available on your source equipment. If your TV or PC is equipped with a headphone jack, for instance, you would simply insert the mini-plug into that and the RCA plugs into the transmitter. Otherwise, you would insert the RCA plugs into the audio-out jacks, and the mini-plug into the transmitter. Either way, it takes just a couple of minutes to install the batteries, connect to the source equipment, plug in the power adapter, and power up the transmitter and the headphones.

The very brief instruction sheet suggests that the transmitter and headphones be as close as possible to the same height. If that's not possible, tilting the transmitter works quite well. So, if your kids tend to sit on the floor in front of the TV to play Nintendo (with their necks craned at an angle that would send an adult to the chiropractor in a matter of minutes), they'll still be able to use the headphones.

They won't, however, be able to move around the house listening to music. The Nintendo Multimedia Headphones are an infrared system—they won't transmit through walls. As long as you stay in the same room (and that room is not more than 25 feet long), you'll be able to hear everything. The infrared emitters are strong enough and broadcast over a wide enough angle that reception is ensured as long as you're in the room. Turn your head away, and reception stays clear, thanks to reflections of the signals off the walls. Step out the door, however, and the automatic mute function steps in, cutting off sound completely.

While the blurb on the box promises "sleek lightweight styling," to anyone accustomed to bud-style portable-stereo headphones, these will seem a bit hefty. They are comfortably padded, both on the ear pieces and the headband, however—and if you really get into game play, you'll hardly notice they're there.

As far as sound quality, the Nintendo Multimedia Headphones claim a frequency response of 35–18,000 Hz; a signal-to noise-ratio of 60 dB; total harmonic distortion of less than 0.5%; and a channel separation of 45 dB. While we didn't use test instruments to verify those specifications, our listening tests gave us no reason to doubt them. They sounded quite good whether we were listening to music, watching a video, or playing games.

The headphones did suffer from an almost insignificant hum. It sounded like a 60-Hz hum caused, we suspect, by a noisy AC adapter. While audible with no signal input, it was totally masked by any program material.

We prefer to do our music listening through standard speakers, and generally don't find TV engrossing enough to warrant shutting out ambient sound (such as conversation with other family members). Still, these headphones performed admirably in both situations. When playing computer or video games, however, we actually preferred wearing the headphones. They gave us a greater sense of being "in" the game, surrounded by the action—and gave some peace and quiet to others around us. ■

GIZMO NEWS

FCC endorses TV rating system

On March 12, the Federal Communication Commission gave a stamp of approval to the voluntary video-programming rating system officially known as the TV Parental Guidelines, but more often referred to by the name of the technology needed to implement it: the V-chip. The rating system, which was jointly created by the National Association of Broadcasters, the National Cable Television Association, and the Motion Picture Association of America, is intended to offer "category and program-specific content indicators" that "provide parents with information that will help them make decisions about what their children should watch on television."

The FCC also revealed technical requirements for the rating system's implementation, establishing technical rules that require half of all new television sets with screen sizes 13-inches and larger to be equipped with "V-chip" technology by July 1, 1999, and all such models to include the V-chip by January 1, 2000. Personal computers that are equipped with TV tuners and appropriately sized monitors will also be required to carry the V-chip.

There are several facets to the TV Parental Guidelines. Six descriptive labels indicate a program's appropriateness in terms of a child's age and/or maturity level, and content indicators provide more specific warnings concerning sexual situations, violence, and offensive language or dialogue. The rating labels and content indicators are transmitted on line 21 of the vertical blanking interval and appear on screen for 15 seconds at the beginning of all rated programming. Broadcasters are also expected to provide rating information to newspapers and publishers of printed and electronic program guides. Finally, an Oversight Monitoring Board has been established to ensure that the guidelines are applied accurately and consistently. News, sports, and unedited MPAA-rated movies are exempt from the ratings.

There are two ratings specifically for children's programming: TV-Y, for shows deemed appropriate for all children, and TV-Y7, which might contain themes and elements that could frighten children under the age of seven. Ratings for general programming include: TV-G, suitable for all ages; TV-PG, parental guidance suggested; TV-14, contains material that many parents would find unsuitable for pre-teens; and TV-MA, for mature audiences only due to graphic violence, explicit sexual activity, or indecent language.

FCC Chairman William Kennard commended Congress "for its foresight in passing the V-chip legislation and providing leadership and guidance on this issue," and "the many children's advocacy groups and television industry groups ... for working cooperatively to produce the rating system," which he called "particularly useful for working parents who can't always be present to monitor the TV watching of their children."

In a separate statement, Commissioner Harold W. Furchtgott-Roth lauded the TV Parental Guidelines as a prudent "alternative to a government-created, government-policed scheme for judging the content of video programming." He emphasized that the FCC order "should *not* be interpreted as a basis for future governmental efforts to compel adherence to the industry guidelines." Furchtgott-Roth continued, "I salute the courage and fortitude of those programmers, such as NBC and BET, who have resisted political pressure to effectively convert these voluntary guidelines into mandatory regulations...That, after all, is what the First Amendment is all about."

Commissioner Gloria Tristani, on the other hand, was concerned that NBC and BET, by deciding not to participate in the current ratings system, "will make it more difficult for parents to program the V-chip using the Industry proposal." She expressed hope that "all video programming distributors will perceive the public interest in making the V-chip a more effective and easy-to-use tool for parents to block programming they deem harmful to their children."

Dissenting programmers are allowed to come up with their own rating systems, and the FCC encourages manufacturers to design TVs that can accommodate additional rating systems "to the extent practical." But that is a far cry from requiring TVs to provide for more than one system.

The addition of the V-chip is not expected to significantly increase the cost of new televisions. According to a spokesman from the Consumer Electronics Manufacturers Association, the added cost to a high-end set would be "negligible," while less expensive sets might go up by $10 to $20.

Home wireless communications specification

A group of PC, communications, and consumer-electronics companies have formed the Home Radio Frequency Working Group (HRFWG) with the intention of developing a new specification for wireless communications in the home. The open specification, expected to be published later this year, is called the Shared Wireless Access Protocol, or SWAP, and will allow PCs, PC peripherals, and consumer-electronic products to interoperate wirelessly. The group expects the first SWAP-compatible products to reach the market in the second half of 1999.

The HRFWG—informally dubbed the HomeRF Group—includes representatives of Compaq Computer Corporation, Ericsson Enterprise Networks, Hewlett-Packard, IBM, Intel, Microsoft, Motorola, Philips Consumer Communications L.P., Proxim, Samsung Electronics America Inc., and Symbionics. It is supported by Butterfly Communications, Harris Semiconductor, Intellon, National Semiconductor, and Rockwell Semiconductor Systems.

According to Microsoft, the group's goal is "to provide the foundation for a broad range of inter-operable consumer devices by establishing an open industry specification for wireless digital communication between PCs and consumer-electronic devices anywhere in and around the home." Home-networking technologies have been hindered by the high cost and impracticality of wiring, and by the presence of several incompatible wireless communications standards.

"We believe that by establishing a wireless communications specification for the home, a new industry will be created that results in unprecedented interoperability between intelligent devices in the home," said Ben Manny, HRFWG chairman and engineering manager for residential networking at Intel's Architecture Labs. "For example, with HomeRF technol-

ogy, users will be able to spontaneously access their PCs from anywhere in the house or yard."

That's not all that consumers will be able to do once SWAP is adopted. The interface specification is expected to allow users to set up a wireless home network to share voice and data between peripherals, PCs, and new devices such as portable remote display pads; review incoming voice, fax, and e-mail messages from a cordless telephone handset; forward incoming telephone calls to multiple cordless handsets; fax machines, and voice mail boxes; use portable display devices to access the Internet from anywhere in the home or yard; and activate other home electronic systems by speaking a command into a cordless handset.

Soaring satellite rates

This past year, the U.S. Copyright Office ruled to quadruple the rate that satellite broadcasters must pay to transmit network television signals. The new rates could put an extra $60 million a year into the pockets of copyright owners, including networks, Hollywood studios, and major league sports teams. Hardest hit are direct broadcast satellite (DBS) companies including DirecTV, Primestar, and Echostar, who, under the ruling, must pay more than their cable rivals for the same programming.

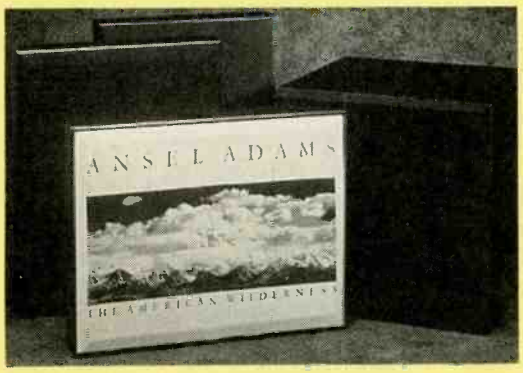
The increased rates were scheduled to go into effect January 1, 1998. In the meantime, the DBS industry, with some help from Congress, plans to fight the ruling. Ken Johnson, a spokesman for Louisiana Representative W.J. Tauzin, Chairman of the House Subcommittee on Telecommunications, said, "The decision defies common sense. It will force consumers to pay dramatically higher rates for satellite services, and at the same time slow down competition in the marketplace."

The Satellite Broadcasting and Communications Association intends to challenge the ruling in court, and the group has asked the Copyright Office to put its decision on hold until the case can be heard by the Federal Appeals Court in Washington according to Andy Paul, SBCA senior vice president. DirecTV, along with Primestar and Echostar, also plan to challenge the ruling in court. The new rates "really will place a substantially higher financial burden on satellite companies compared with fees cable systems pay for the exact same signals," said DirecTV senior manager of communications, Bob Marsocci.

Under the ruling, in order to retransmit programming satellite carriers must pay a monthly charge of 27 cents per signal for each subscriber. The current monthly per-signal charge for each subscriber is 6 cents for network signals, 14 cents for stations that have national rights to all of their syndicated programming, and 17.5 cents for superstations. Cable companies, on the other hand, pay not even 10 cents a month per signal per subscriber for superstations, and less than 3 cents for distant network signals. However, royalty payments are structured differently for the two industries, with cable operators paying fees based on a percentage of gross subscriber payments.

Along with the new rates, the Copyright Office also clearly stated the circumstances under which DBS companies may deliver local network signals: Only in those cases where a customer has no access to local signals either over the air or via cable. In such cases, the DBS operators do not have to pay any royalties. ■

WISH LIST



NCT Audio Products Gekko Flat Speakers

Chameleon Speakers

Gekko Flat Speakers from *NCT Audio Products Inc.* (subsidiary of Noise Cancellation Technologies, Inc., One Dock Street, Suite 300, Stamford, CT 06902; Tel. 800-278-3526; Web: *www.nct-active.com*) feature patented Flat Panel Transducer technology that evenly disperses high-quality sound from a unique, flat enclosure designed for wall mounting. The resulting "Sweet Space" means that the music sounds just as good from every seat in the room, as opposed to one precise "sweet spot." Less than two inches in depth and framed in sleek wood cabinets, the speakers are available in three sizes: 9 × 11, 11 × 14, and 18 × 24 inches. If desired, the speaker grille can be popped off and replaced with a custom grille featuring any of hundreds of art-print selections. The ArtGekko Collection of replacement grilles includes full-color, high-resolution, digitally printed reproductions, ranging from fine art to celebrity and movie posters, from children's prints to photography. You can even purchase a replacement frame in simple wood or more ornate gold or pewter styles. Prices vary widely depending upon configuration. Bundled 11 × 14-inch speaker options, for instance, range from a three-speaker "home theater upgrade to existing stereo speakers" (without subwoofer) for $500 to a complete five-speaker plus subwoofer home-theater system for $2000. ■

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Theresa Lombardo

Theresa Lombardo
Circulation Manager

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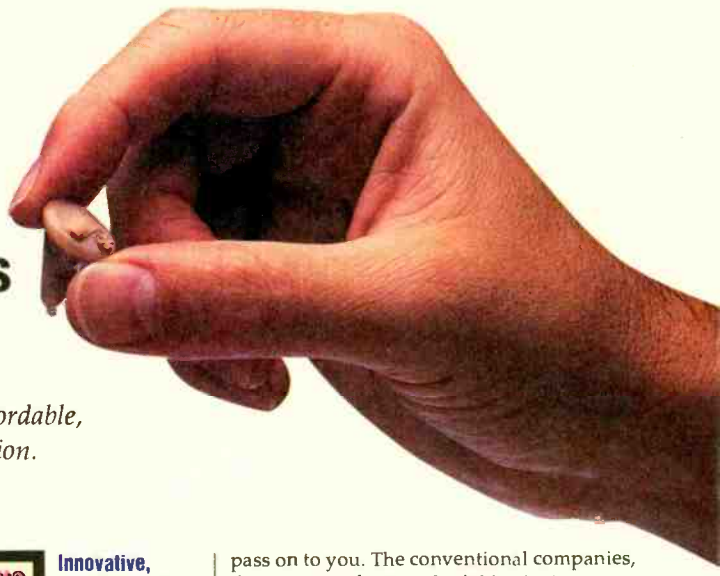
One scientist's vision revolutionizes the hearing industry, benefiting millions of people...



Crystal Ear® uses sophisticated electronics to provide affordable, cosmetically-pleasing and easy-to-use hearing amplification.

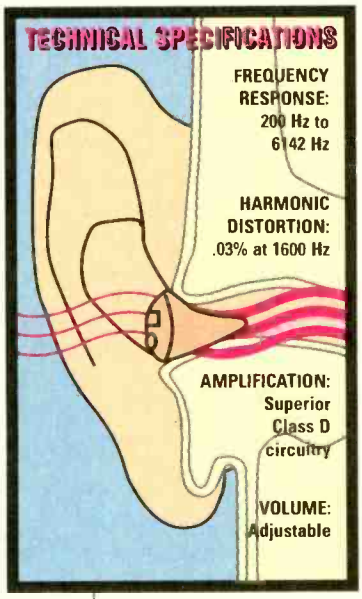
by Harold Sturman

One day a friend asked my wife Jill if I had a hearing aid. "He certainly does," replied Jill, "Me!" After hearing about a remarkable new product, Jill finally got up the nerve to ask me if I'd ever thought about getting a hearing aid. "No way," I said. "It would make me look 20 years older and cost a fortune." "No, no," she replied. "This is entirely different. It's not a hearing aid...it's Crystal Ear!"

No one will know. Jill was right. Crystal Ear *is* different—not the bulky, old-styled body-worn or over-the-ear aid, but an advanced personal sound system so small it's like contacts for your ears. And Crystal Ear is super-sensitive and powerful, too. You will hear sounds your ears have been missing for years. Crystal Ear will make speech louder, and the sound is pure and natural.

I couldn't believe how tiny it is. It is smaller than the tip of my little finger and it's almost invisible when worn. There are no wires, no behind-the-ear devices. Put it in your ear and its ready-to-wear mold fits comfortably. Since it's not too loud or too tight, you may even forget that you're wearing it! Use it at work or at play. And if your hearing problem is worse in certain situations, use Crystal Ear only when you need it.

A fraction of the price. Hearing loss is the world's number-one health problem, but in most cases it goes completely untreated. For many millions of people, hearing devices are way too expensive, and the retail middlemen want to keep it that way. What's more, treating hearing loss the old retail way can involve numerous office visits, expensive testing and adjustments to fit your ear. Thanks to Crystal Ear, the "sound solution" is now affordable and convenient. Almost 90% of people with mild hearing loss, and millions more with just a little hearing dropoff, can be dramatically helped with Crystal Ear. Plus, its superior design is energy-efficient, so batteries can last months, not just weeks.



Innovative, breakthrough technology solves common problem...

Hearing loss, which typically begins prior to teenage years, progresses throughout one's lifetime. Nearly 90 percent of people suffering the type of loss Crystal Ear was designed for choose to leave the problem untreated. Crystal Ear is now available to help these people treat their hearing loss with a small and very affordable Class I in-the-canal hearing amplifier.

You'll feel years younger! Wear Crystal Ear indoors, outdoors, at home and at work. Crystal Ear arrives ready to use, complete with batteries, two different fitting sleeves, a cleaning brush and even a carrying case. Crystal Ear is a breakthrough advance in the hearing device field. It is made in the USA, using state-of-the-art micro-manufacturing techniques that cut costs dramatically—savings that we can pass on to you. The conventional companies, domestic and foreign, don't like that!

Don't be fooled by high prices. No hearing device, no matter how expensive, can eliminate background noise, despite claims by the manufacturers. Crystal Ear does not promise miracles—just an affordable, sound solution to many common hearing problems.

COMPARE CRYSTAL EAR AND SEE THE DIFFERENCE

	MOST IN-CANAL BRANDS	CRYSTAL EAR
Require fitting	Yes	No
Require testing	Yes	No
Battery life	160 hours	320 hours
Impact resistance	Average	Excellent
Whistling/feedback	Frequent	Limited
Telephone use	Yes	Excellent
Retail price	$1,000-2,000	$299.85

DON'T TAKE OUR WORD FOR IT...

"My father spent over $5000 on another brand. I showed him my Crystal Ear, he tried it, and he decided it worked better than his brand, even though it was a small fraction of the cost!"

—A satisfied Crystal Ear user

"Over 32 million Americans experience some loss of hearing. Though most cases go untreated, over 90 percent of these people would be disappointed to learn from their doctor that there is no medical or surgical cure. There is, however, an effective treatment: electronic amplification."

—Dr. Dale Massad, MD

Risk-free. Try Crystal Ear and hear what you've been missing. It comes with a 90-day manufacturer's limited warranty as well as our risk-free home trial. If you're not satisfied, return it within 30 days for a full refund.

Crystal Ear®:
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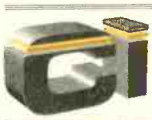


comtrad industries
2820 Waterford Lake Dr., Suite 102
Midlothian, Virginia 23113

PRODUCT TEST REPORT

Aiwa XP-SP1200 Portable CD Player

STEPHEN A. BOOTH

Usually, portable compact-disc players aren't the best musical companions for jogging, gymnastics—or even a bumpy bus ride. It doesn't take a lot of g-force to make the laser pickup do a digital imitation of a phonograph tonearm. Environmental conditions are yet another drawback. Moisture in the form of rain, condensation, or perspiration can be murder on electronics components. Even on a sunny day at the beach, there's salt air and spray to consider—or sand and grit that have a way of getting into the tiniest openings.

For the outward-bound, Aiwa's Cross Trainer series of water-resistant portable audio products offers the opportunity to make CD music a moveable feast (the company also offers cassette players and arm-band or headphone radios). The Aiwa *XP-SP1200 Cross Trainer Portable CD Player* featured here is virtually immune to skipping induced by motion, owing to its Electronic Anti-Shock System (EASS). This stores 40 seconds of music in a buffer memory—adequate time for the laser pickup to recover and find its place without apparent interruption in what you hear.

As for ambient conditions, this weather-resistant player isn't submersible for snorkeling or scuba diving, and it probably isn't the brightest idea to take it on a surfboard or in the shower. But the gaskets for its access ports and the membrane seals for its controls will keep out topical moisture and debris (there are even press-fit plugs for the AC-input and headphone jacks, and the headphone is water-resistant too!).

Meanwhile, sweaty palms aren't likely to lose grip of the Cross Trainer, thanks to its tactile, rubberized surface. Add to this some rugged good-looks: an overall black and purple color scheme with emergency-orange accents for the buttons, compared with the gray-yellow combo found in most outdoors electronics.

Utility and convenience—including

Aiwa XP-SP1200 Cross Trainer Portable CD Player

battery life—are the strong suits of the XP-SP1200. It'll run up to 12 hours on a pair of AA alkaline or rechargeable batteries, though just two hours with the juice-thirsty memory of the EASS feature. Performance-wise, it's no better or different than most headphone portables—which don't have the specs or pedigree of tabletop home CD players. In the accompanying table, you'll find the test results of electrical measurements (using the CBS CD-1 standard test disc) from the Advanced Product Evaluation Laboratory (APEL), an independent testing facility in Bethel, Connecticut.

FEATURES AND EVALUATION

Besides the EASS, which works exactly as promised, there are other likeable features to the XP-SP1200. These include its three-LED (green-orange-red) battery-life indicator. When the red indicator illuminates, it's time for a fill-up—no foolin'! It means Empty, not Extra.

To swap those batteries, you have to open the gasketed disc compartment, which houses the battery reservoir and thereby eliminates a potential entry port for moisture. You'll also find two switches under the hood for functions you probably won't change often—the DSL and Resume features. The latter instructs the player to pick up playing wherever it left off, in the event you pause or stop play. DSL, for Dynamic Super-Linear bass, offers two levels of enhancement for low frequencies.

If you use rechargeable batteries (*e.g.*, the 1.2-volt NiCd at 600 mA), you can charge them right in the player. To this end, Aiwa includes an AC-to-6-volt DC transformer. Ironically, no batteries of any kind are packaged with the player, probably because Aiwa (unlike Panasonic, Sanyo, Sony, or even Kodak) isn't in the battery business. This could be disappointing if you first open the package on an airplane, or on Christmas morning. By the way, to conserve the batteries, the Cross Trainer has an auto-off function that shuts off power two minutes after programmed play ends.

Most controls on the XP-SP1200 are pretty typical—volume, pause/standby, forward and reverse search, repeat play, and stop. You can program up to 24 selections in any order, by using the forward and reverse buttons then hitting the DISPLAY/ENTER key to make your choice. Random play is also possible, whereby the Cross Trainer shuffles the cards and deals. In this mode, though, you can't search back to previously-played tracks.

PERFORMANCE

Reading between the lines of APEL's measurements should allay most people's concerns about damaging their hearing from excessively-loud headphone listening with the XP-SP1200. Even at the highest volume settings, this portable doesn't play very loud.

As you can see, APEL's measurement for Total Harmonic Distortion doesn't go beyond 4 kHz. According to the lab, the player's level didn't get high enough to yield a meaningful measurement at 8 kHz (output to the headphones is just 418 mV). It doesn't take any reading between the lines to realize this means the XP-SP1200 has very narrow dynamic range—frequency response was down 7 dB at 20 Hz (although the player can compensate at the bottom end with its two levels of

TEST RESULTS

AIWA XP-SP1200 CROSS TRAINER PORTABLE CD PLAYER

Brand:	Aiwa
Model:	XP-SP1200
Price:	$180 suggested retail
Output Voltage (@ 0 dB, 1 kHz)	
Left:	418 millivolts
Right:	415 millivolts
Frequency Response (20 Hz to 20 kHz):	−7.00 dB to +0.12 dB
Signal-to-Noise Ratio ("A" Weighted):	78.0 dB
Total Harmonic Distortion + Noise (@ -10 dB)	
Frequency	THD (%)
31 Hz	0.096
1 kHz	0.073
4 kHz	0.128
8 kHz	—
Wow & Flutter:	Unmeasurable
Channel Separation (re: 0 dB, 1 KHz):	
Left:	59.0 dB
Right:	67.2 dB
De-Emphasis Error:	
Frequency	Error (dB)
1 kHz	0.0
4 kHz	0.08
16 kHz	0.0
Linearity Error (@ 1 kHz):	
Signal Level (dB)	Error (dB)
0	0.0
−10	−9.7
−20	−19.7
−30	−29.9
−39.99	−39.8
−49.97	−49.5
−59.94	−56.6
−70.31	—
−80.77	—
−90.31	—
Linearity Error with Dither (@ 1 kHz):	
Signal Level (dB)	Error (dB)
−70.31	Too Low
−80.77	Too Low
−90.31	Too Low
−100.0	Too Low
ADDITIONAL DATA:	
Short Access Time (Track 1 to 2):	1.85 seconds
Long Access Time (Track 1 to 21):	4.79 seconds
Power Requirements:	2.5 watts
Dimensions (H × W × D, inches):	$1\text{-}^3/_8 \times 5\text{-}^1/_2 \times 6\text{-}^1/_2$
Weight:	$13\text{-}^1/_2$ ounces

DSL electronic bass-boost).

Otherwise, signal-to-noise is typical of portables, though a far cry from the 100 dB you might get from a home player. Channel separation is adequate for headphone use, where the output is in such near proximity to the ears compared with diffusion that would occur in a room setting with loudspeakers. Meanwhile, the Cross Trainer's 8× oversampling and 1-bit digital-to-analog (DAC) converter excel in the areas of de-emphasis and linearity error. Test results for each rival tabletop players, although this unit's low level means there wasn't much linearity error to measure beyond −59.94 dB.

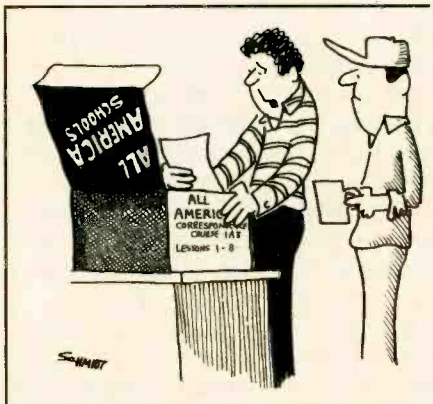
That's where the only significant shortfall (3.34 dB) occurs. The test for linearity error measures whether the player's DAC translates each of the 65,536 possible digital codes on the CD to its exact frequency and level. Although an error of 3 dB is considered to be audible, it probably won't be with the XP-SP1200 owing to the player's low output level.

FEATURES CHART:

- 40-second anti-shock buffer memory
- Water- and debris-resistant construction
- Water-resistant headphone
- Rubberized exterior surface
- Three-LED battery life indicator
- 12-hour playback (without anti-shock)
- User-programmable track play
- Automatic random-play (24 tracks)

CONCLUSION

Because deployment in the field is the Cross Trainer's reason-to-be, comparing specifications with home CD players isn't valid. And to do so isn't even fair to tabletop machines—in one area of performance. Not many would play without skipping as the XP-SP1200 did when subjected to some rude handling, including APEL's 36-inch drop test, where the EASS memory proved its worth. Further information can be obtained by contacting Aiwa America, Inc., 800 Corporate Drive, Mahwah, NJ 07430; Tel. 800-BUY-AIWA; Web: *http://www.aiwa.com*; or circle no. 100 on Free Information Card. ■



"It's my TV course from 'All America School.' The parts are Korean; the computer, Japanese; and the manual, French!"

Electronics Library

ARRL NET DIRECTORY, 1997-1998 EDITION

from The American Radio Relay League

This directory shows amateur radio nets that have been registered with the ARRL. It primarily covers nets that are of interest to amateur-radio operators in the U.S. and Canada. World-wide coverage nets and maritime service nets are also featured, as are National Traffic System Area and Region Nets. One focus of the directory is toward public-service oriented nets that support the ARRL National Traffic System (NTS) and the Amateur Radio Emergency Service (ARES).

All nets are in alphabetical order. In state listings, VHF nets are recorded first, followed by HF nets. The wide-coverage nets are sorted by frequency bands. As an additional guide, registered HF (150- to 10-meters) are sorted by frequency in ascending order in the Net Frequency List. The lists provide the net name, frequency, days the net meets, the time of meeting, and net manager.

Also included are a time conversion chart, instructions on how to write and send formal ARRL NTS messages, and an explanation of Q signals.

The ARRL Net Directory costs $4 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111-1494; Tel. 888-277-5289 or 860-594-0200; Fax: 860-594-0259; Web: www.arrl.org.

CIRCLE 90 ON FREE INFORMATION CARD

NOW HEAR THIS! ELECTRONIC EAVESDROPPING EQUIPMENT DESIGN

by Winston Arrington

Electronic eavesdropping equipment is covered in depth in this 126-page revised edition. This book contains 117 schematic diagrams along with explanatory text. A thorough knowledge of electronics is essential for constructing this equipment, including knowing how to build projects from a schematic.

The introduction gives an overview of surveillance techniques and presents an extract from Title III, the law on wiretapping and electronic surveillance. Each chapter starts with a discussion of the theory behind the transmitters and explains their advantages and disadvantages. The last chapter, written by Kevin Murray, an expert in the field, discusses counter-surveillance techniques and counter-measure-detection equipment.

Plans are given for 29 crystal-controlled transmitters of all types, 35 room-surveillance transmitters—both battery-powered and plug-in—and 32 telephone devices. Schematics for phantom zero subcarrier transmitters, infrared units, and high-impedance recorder activators are also included.

Now Hear This! costs $65, plus shipping, and is published by Sheffield Electronics Co., P.O. Box 377940, Chicago, IL 60637-7940; Tel. 773-324-2196.

CIRCLE 91 ON FREE INFORMATION CARD

1998 GENERAL CATALOG

from Contact East, Inc.

Filled with hundreds of new test instruments and tools for engineers, managers, technicians and hobbyists, this 284-page catalog features products from brand-name manufacturers for testing, repairing, and assembling electronic equipment.

New product highlights include Fluke's redesigned 70 "Series III" DMMs, Tektronix' TDS "600 Series" digital real-time oscilloscopes, and Metcal Rework Stations. There is also a full selection of DMMs, portable and benchtop digital storage scopes, custom tool kits, power supplies, EPROM programmers, soldering and desoldering equipment, breadboards, heat guns, measuring tools, adhesives, precision hand tools, and reference books. Also included are their popular lines of communication test equipment, ESD protection products, ozone-safe cleaners, magnifiers, inspection equipment, workbenches, and tool cases.

The General Catalog is free upon request from Contact East, Inc., 335 Willow Street, North Andover, MA 01845; Tel. 978-682-2000; Fax: 978-688-7829; Web: contacteast.com.

(Continued on page 63)

Philips Audio Compact Disc Recorder

Play, or create and record audio programs to writable and rewritable CDs.

Create your own CDs. That is the one thing CD fans have been waiting for—the ability to record onto blank CDs. With the Philips *CDR870 Audio Compact Disc Recorder* jacked into your system, you can record high-quality audio CDs from both analog and digital sources. Now you can establish your own personally-edited library of CDs, mixing and matching your personal favorites in the sequence you want to hear them. Take from hundreds of sources and record those you wish onto one or more CDs. Of course, if you revert back to listening to albums, the CDR870 will play all your prerecorded CDs. Just chose your source and press play or record. The CDR870 can also write and read both CD-R (CD Recordable) and CD-RW (CD Recordable-Rewritable) media.

The CDR870 is designed to fit the dimensions of most stackable audio systems. Installation and setup for the CDR870 is simple and straightforward. In fact, it is comparable to the installation of any consumer CD-player or cassette deck. Connectivity is provided for analog, digital, and optical data transfer from a preamplifier or direct from a CD player, DCC recorder, DAT recorder, or digital broadcast satellite receiver. Should you require help, the User Manual is adequately illustrated to assist you.

Operational Controls and Display. The front-panel controls are ample for total control of the unit, yet simple enough to understand. The remote control supplied with the CDR870 provides more detailed control over the CD's playback. Additional features on the remote control include a number pad for precise track selection and forward/reverse search buttons. The User Manual

Philips CDR870 Audio Compact Disc Recorder

makes understanding the controls and LED display simple, despite the display's apparent complexity.

Recording. Recording is done in real-time, and the typical CD recordable media can store up to 74 minutes of audio. The audio quality during playback is remarkably brilliant, even when recording from an analog tape source. Caution must be taken not to exceed the recommended recording level, otherwise distortion can easily occur during playback. Once the disc is full or you're finished recording, the disc must then be "finalized." Finalizing a disc takes approximately two minutes, and it is an easy process. You must finalize a CD-R disc in order to play it on any conventional CD player.

There are some pitfalls. CD-RW media can only be read on CD-RW devices or on newer multi-session CD-ROM drives. Also, only the last recorded track can be erased on a disc that has not been finalized. (*i.e.* to erase track 6 of 8, you must first erase track 8, then 7 and then track 6). This characteristic discourages dumping many recordings on the CD media and then trying to edit the contents from beginning to end. However, planning ahead will greatly eliminate unneeded editing. Should you want to erase the entire disc, that is a simple procedure requiring two presses of the Erase button. However, be careful should you want to erase only the last track, which requires only one press of the Erase button.

Normal Care. The CDR870 (like other audio components) requires cleaning of the external surfaces from time to time. Slightly moisten a piece of chamois leather with water and wipe the surfaces clean. Do not use cleaning agents containing alcohol, spirits, or abrasives.

CDs require care, and the presence of fingerprints or smudges on the disc surface will not directly affect the recorded signals but, depending on the degree of contamination, the brightness of the reflected signal may be reduced sufficiently to degrade the sound quality. Keep the shiny surface of the disc clean. Use a soft lint-free cloth and always wipe the disc in a straight line from center to edge. Never use cleaning agents intended for conventional records, and never use detergents or abrasive cleaning agents.

When writing on the printed (label) side of a CD, use a soft, felt-tipped marker. Never use a hard-tipped pen (such as a ball-point). This may damage the recording.

Conclusion. After copying a few songs for the first time to a writable CD, the reviewer seriously considered selling off his cassette recording equipment before the market prices fell. Writing to CDs is a whole new experience, and the Philips CDR870 is the perfect tool for that task. The suggested retail price is $649.00. And with a street price expected to be lower, the CDR870 is a worthy addition that will make your audio system complete. Further information can be obtained by contacting Philips Electronics, 64 Perimeter Center East, Atlanta, GA 30346; Tel. 770-821-2400; Web: *http://www.philips.com*; or circle no. 120 on Free Information Card. ■

Build the E.Z. SIGNAL GENERATOR

Popular Electronics®
July 1998

Add this easy-to-build, wide-range, function generator to your bench-top troubleshooting arsenal for a fraction of the cost of commercial units!

SKIP CAMPISI

If you enjoy experimenting with analog circuitry such as audio, communications, instrumentation, and other such circuits, you'll agree that a good, wide-range signal generator is a necessity. By now you've realized that commercial units are rather expensive.

A decent function generator usually lists for about $175 and up, depending on how many "bells and whistles" are added to the basic unit. But the *E.Z. Signal Generator* described in this article can be assembled for less than a third of the cost of commercially available units, and still provide equal range coverage!

The usual monolithic (single-chip) function generator designs, which provide sine-, triangle-, and square-wave outputs, were discarded in favor of this design. Monolithic chips only provide clean waveforms up to about 200 or 300 kHz, and the sinewave output is quite tricky to smooth out even over that limited range.

The design presented here—built around discrete, high-speed amplifiers—achieves much better results. All three waveforms are clean over a range of 10 Hz to 2 MHz, and the output is variable from zero to ±10 volts, while supplying up to 25 mA or more. The unit has five basic ranges, which can be varied from ×0.1 to ×2.0 of full-scale. A specially-designed sinewave converter provides very clean sinewaves over the entire range of the generator.

About The Circuit. A schematic diagram of the E.Z. Signal Generator is shown in Fig. 1. The frequency-generating portion of the circuit is built around five ICs—an LT1016 ultra-fast comparator (IC1), an LF351 JFET op-amp (IC2), three LM6361 high-speed op-amps (IC3–IC5), and a batch of passive components. That keeps circuit operation simple and fault-free.

In the frequency-generating circuit, IC1 (which has a response time of around 10 nanoseconds) is configured as a hysteresis amplifier. Note that IC1 has two outputs Q and $\overline{Q}$ (at pin 7 and pin 8, respectively, which are TTL-compatible complementary outputs). A pair of resistors, R3 and R4 (tied to the Q output of IC1 at pin 7) provide positive feedback to IC1's non-inverting input at pin 2. As the TTL complementary outputs were not intended to drive resistive loads, a snubber circuit (composed of R2 and C7) was added to control voltage spikes on the square-wave outputs.

As the TTL levels of the square wave are fixed at about +3.5 volts (high logic level) and +0.3 volts (low logic level), IC2 (the LF351) is configured to provide a reference level of +1.9 volts (half way between the TTL levels) for the rest of the circuit.

The square-wave output of IC1 is applied to R8, a 500-ohm, linear-

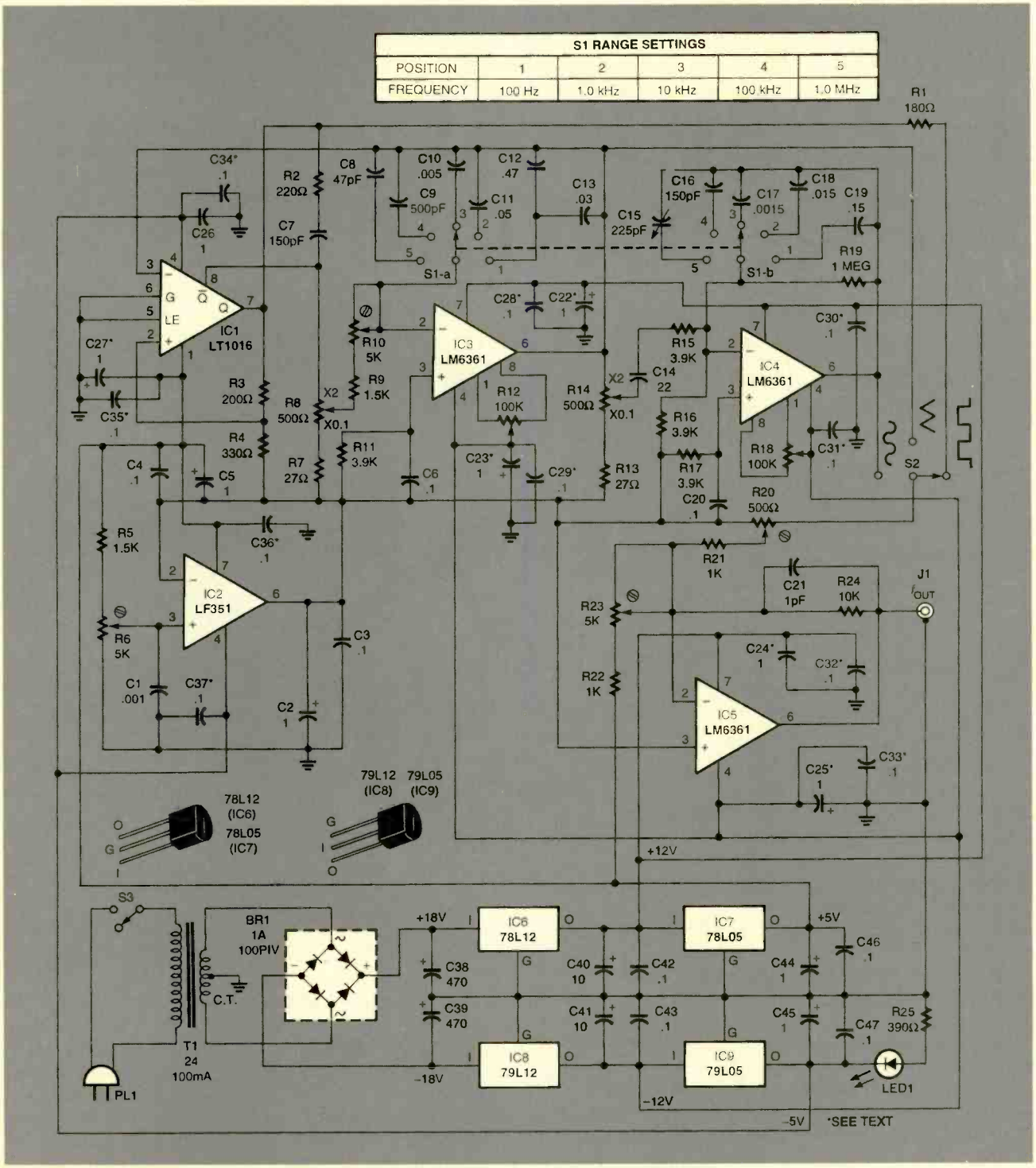


Fig. 1. The E.Z. Signal Generator is built around nine ICs—an LT1016 ultra-fast comparator (IC1), an LF351 JFET op-amp (IC2), three LM6361 high-speed op-amps (IC3–IC5), and four fixed-voltage regulators (IC6–IC9)—a full-wave bridge rectifier (BR1), a 24-volt, 100-mA transformer, an LED, and a batch of passive components.

taper slide potentiometer that is used as a frequency-multiplier control. At its minimum setting, R8 produces a multiplying factor of ×0.1, which increases linearly to ×2.0 at its maximum setting. The attenuated square-wave output of IC1 is applied to IC3 (an LM6361 high-speed op-amp), which is configured as an integrator. The integrator produces a triangle-wave output that swings from +2.9 volts down to +0.9 volts. The output of IC3 at pin 6 is fed back to the inverting input of IC1at pin 3. Together IC1 and IC3 form a classic hysteresis/integrator function generator. Using the +1.9 volt as a reference, the square-wave output is now ±1.6 volts and the triangle-wave output is now ±1.0 volt. Switch S1-a is used to select the full-scale

frequency range of the circuit (100 Hz, 1 kHz, 10 kHz, 100 kHz, or 1 MHz).

The triangle-wave output of IC3 is fed through R14—a 500-ohm, linear-taper, slide potentiometer that is "ganged" with R8 (the frequency multiplier)—to IC4 (another LM6361), which is also configured as an integrator. The second integrator shapes the triangle wave into a parabolic type of waveform with an amplitude of ±1.0 volt.

That pseudo-sinewave is actually very close in shape to a true sinewave, and the harmonic distortion is comparable to that produced by single-chip monolithic function generators. The zero-crossings are slightly steeper than a sinewave, with the maximum excursions being slightly rounder. However, the waveform is absolutely smooth over the entire frequency range, unlike monolithic circuitry, which is highly dependent on frequency.

Note: Capacitor C14 (the 22-μF input capacitor for IC4) must be a *bi-polar* electrolytic unit. That type of unit is rated for continuous AC voltage, as opposed to *non-polarized* units, which are rated for intermittent duty only.

Switch S1-b, which is ganged with S1-a (RANGE SELECT), selects the proper integrating capacitor. As already stated, R8 and R14 are potentiometers that are ganged together. A standard dual-ganged rotary potentiometer could have been used here, but in the author's experience, the taper matching between both sections leaves something to be desired.

The sinewave output of IC4 remains at a constant level (as the frequency multiplier is varied) when the tapers of R8 and R14 track together. Fortunately, slide potentiometers track extremely well due to their mechanical construction. Thus, it is worth the extra effort to mount and gang the units.

The three waveforms are fed to switch S2 (FUNCTION), which is used to select the signal that's fed to IC5 (the final LM6361). That amplifier is configured as an inverting amplifier and has a gain of −10. The output of IC5 is level-shifted down from the +1.9-volt reference so that the output waveforms are now symmetrical about circuit ground. That allows maximum output-voltage swings from zero to ±10 volts, which is controlled by R20 (the AMPLITUDE control).

From R20, the selected waveform is fed through R21 to the inverting input of IC5. Resistor R23 allows precise adjustment of the output symmetry. Capacitor C21 (a 1-pF unit) is used to compensate for the cable capacitances seen by IC5's input and the output appearing at J1. Any standard BNC cable assembly less than 3 feet long is suitable for the output.

Power-supply bypassing is a very important consideration for high-frequency amplifier performance—IC3–IC5 are 50-MHz amplifiers with 300-volt per microsecond slew rates. To keep those ICs stable and functioning properly, supply-lead inductance has to be dealt with.

Those amplifiers switch at such high speeds that any lead inductance produces glitches in the supply lines, which can enter the amplifiers and be transmitted from one IC to another, causing false signals to be amplified and appear as outputs. The cure for that problem is to connect capacitors from the power-supply terminals of each IC to ground. Because of their small physical size, 0.1-μF monolithic ceramic capacitors (C28 to C37) are ideal for this application. Note that there are also several 1-μF tantalum units (C22 to C27) as well.

The circuit is powered from a fairly conventional supply circuit comprised of a full-wave bridge rectifier (BR1), four fixed-voltage regulators (IC6–IC9), 10 capacitors (C38–C45), a 24-volt 100-mA transformer, an LED, and a resistor (R25). The power supply is a simple arrangement of ±12-volt regulators directly driving ±5-volt regulators. Note that IC1 and IC2 require a ±5-volt supply, while IC3–IC5 require a ±12-volt supply.

Construction. The author's prototype of the E.Z. Signal Generator was assembled in two parts on separate experimenter's boards: one board contains the signal-generating circuitry, while the other contains the power supply. The circuit was assembled in that manner to avoid the problems that might crop up in this type of device when printed-circuit construction is used. The long traces typically found on printed-circuit layouts would present too much stray inductance and capacitance for the generator to function properly. The two sections were then interconnected through appropriate lengths of hook-up wire.

All of the components required for the circuit are affordable and readily available. The semiconductors are available from Tech America (800-877-0072) or Digi-Key (800-344-4539). The passive components are available from Mouser Electronics (800-346-6873), among many other sources.

The first step in construction is to assemble S1, the range switch. Start by cutting a 5-inch length of #22 (or #24) tinned solid bus wire. Bend $^1/_8$-inch hooks in each end of the wire. Form the wire into a $1^1/_2$-inch diameter hoop, using a C-cell battery or similar round object as a form. Lock the hooks together to complete the hoop.

The capacitors specified in the Parts List for C8–C13 and C16–C19 should be radial-lead units. Start by soldering one lead of C12 to lug 1 of S1; the body of C12 should point straight back from the rear of S1 with its free lead outside of S1's circle of lugs. (Keep all of the leads about $^1/_4$-inch in finished length.) Next install C19 at lug 7 of S1 in a similar manner.

Bend small hooks in the remaining leads of C12 and C19 and install the $1^1/_2$-inch bus hoop on the hooks, concentric with S1's body. The hoop should end up on the same plane as S1's lugs. Position the hoop's connecting joint between lugs 1 and 11 on S1; the joint will be removed later.

Now add C11 to lug 2, C10 to lug 3, C9 to lug 4, and C8 to lug 5. Bend hooks into the remaining leads of C8–C11, and capture the hoop with them. Install C13 in parallel with C12. Now add C18 to lug 8, C17 to lug 9, and C16 to lug 10. If needed, add short lengths of #22 bus wire to C15, the trimmer capacitor, and install it at lug 11. Capture the hoop with hooks in those capacitors' remaining leads.

Make sure to solder all of the joints after checking the installation. When satisfied, cut the piece

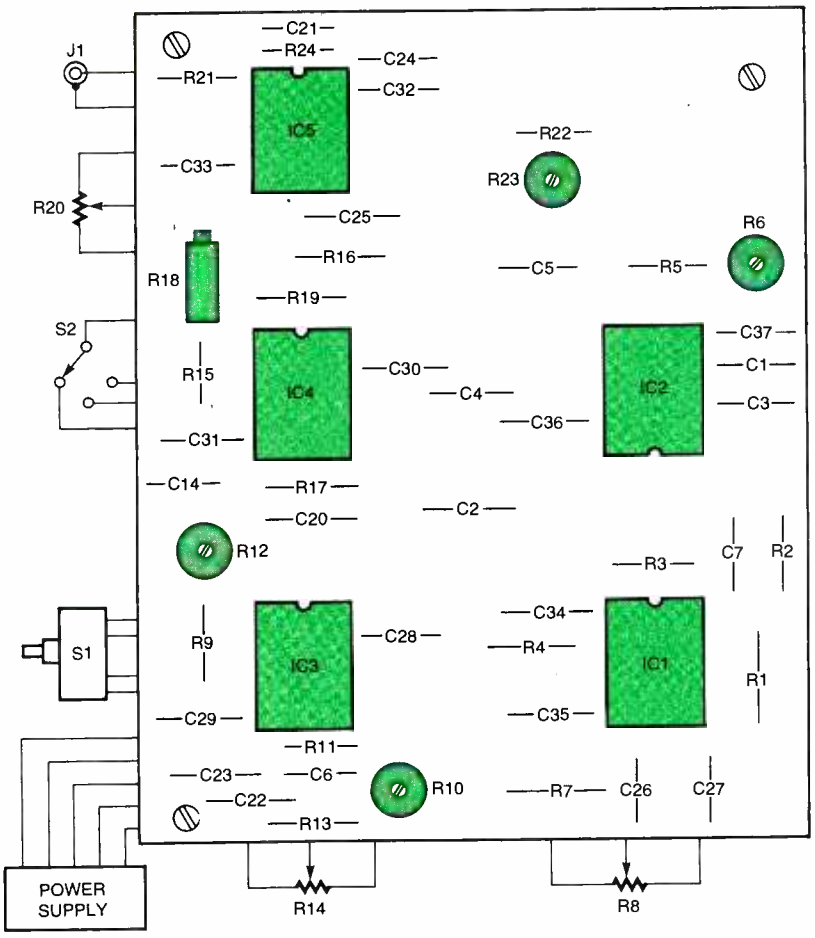


Fig. 2. The E.Z. Signal Generator was assembled on two protoboards: one for the signal-generating circuitry and the other for the power supply. Although the circuit was assembled on protoboard, the circuit layout, nevertheless, should conform to certain design conditions. Shown here is a general layout for the board-mounted components of the signal-generating circuitry of the project. Also shown are inter-board connections between the power-supply and signal-generating boards

of hoop out containing the connecting joint located between lugs 1 and 11. Also, cut out the piece of hoop located between lugs 5 and 7. That produces two "half-arcs" of bus wire, with C8–C13 connected to one section, and C15–C19 connected to the other section. That completes the wiring of S1.

Now take the signal-generating board and examine its foil side. You'll notice two sets of interlocking foil buses spaced on 0.1-inch centers, drilled with holes every 0.1 inch. Surrounding those bus lines are columns of 3-hole foil pads. Figure 2 shows the general locations for board-mounted components of the signal-generating circuitry of the project (as well as inter-board connections).

Install five 8-pin DIP sockets in the approximate locations shown, but **do not** solder them in place yet. The sockets for IC3, IC4, and IC5 should straddle one pair of bus lines, with their pins located in 3-hole pads. The sockets for IC1 and IC2 should straddle a different set of bus lines. An additional pair of bus lines should run between the two columns of sockets. Position the sockets so that there are at least three or four unused 3-hole pads between them; "dry" fit some of the larger passive components to assure proper spacing. Once satisfied, remove the passive components and solder the DIP sockets in place.

The portion of the bus that runs beneath the sockets must be isolated from the rest of the bus pattern; the isolated bus portion will be used for the supply voltages required by the ICs. Isolating portions of the buses can easily be accomplished; simply select a hole in one end of each bus where the bus lines connect together, and increase the size of the hole by drilling it to $^1/_8$-inch diameter. That effectively breaks the foil connection, thereby isolating the desired bus section. Once this task is complete, there should be an isolated pair of bus lines under each column of DIP sockets. Select one bus line from the pair running between the DIP socket columns, and isolate it in a similar manner. The latest isolated bus will be used as the 1.9-volt reference bus. All the remaining (unused) bus lines should be connected together and used as the power-supply ground connection.

Next install 0.1-μF bypass capacitors (C28–C37) at the supply terminals of each DIP socket. The +V terminal of IC1 is located at pin 1; its −V terminal is located at pin 4. The +V and −V supply terminals for the remaining ICs are located at pins 7 and pin 4, respectively. Install C28 at pin 7 of IC3 as follows: Drop one lead into the 3-hole pad connected to pin 7, and the other into the adjacent hole in the ground bus between the socket columns. Don't confuse that bus with the 1.9-volt bus next to it! Solder both leads and cut off the excess lead from the ground connection. Bend the excess lead from the 3-hole pad connection directly over pin 7 and insert it into the adjacent hole in the +12-volt bus running under the socket. Solder the connection. In a similar fashion, install C29 at pin 4 of IC3. Use the outside ground bus this time, with the 3-hole pad connection going to the −12-volt bus. Install C30–C37 in a similar manner at their respective DIP socket terminals, paying attention to the pinouts and supply voltages.

Install the remaining passive components on the board, carefully connecting the components associated with each IC socket one at a time; *i.e.*, connect all of IC1's support components (guided by Fig. 1) before moving on to the next IC's components. Start with the larger components, such as trimmer potentiometers and large capacitors, fitting in the smaller parts around them. You can mount

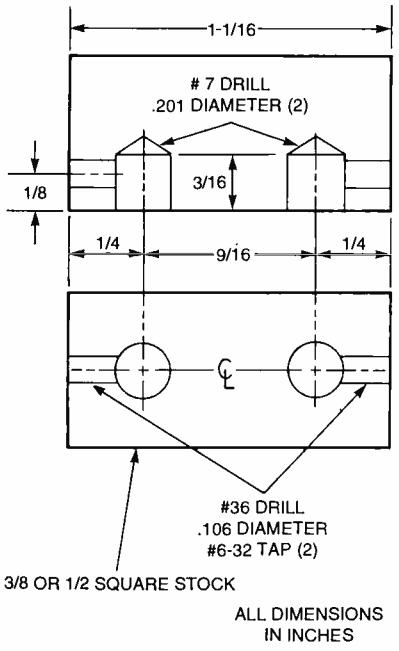


Fig. 3. The technique used by the author to fabricate the custom-knob that was used to gang the slide arms of the two frequency-multiplier potentiometers (R8 and R14) is shown here. Other methods can be used to accomplish the same task.

parts and jumpers on the foil side of the board when necessary. Use #22 tinned bus wire (insulated where necessary) for inter-component connections. If it becomes necessary to run more than one component lead into a single hole, widen the hole by drilling it open with a #55 (0.052-inch) drill bit. One thing to keep in mind when wiring the circuit is to keep all leads as short and direct as possible—and **do not** bundle unshielded wires together!

Leave a hole open for each interconnection between the board and the front-panel controls. Using #22 stranded, insulated hookup wire, install 6-inch lengths in the appropriate holes for connection to the off-board components. If possible, use color-coded wires to help relieve the confusion. The three input lines to S2, taken from the sine-, square-, and triangle-wave outputs, are made using small diameter coaxial cable (such as RG-174). The center conductors are connected between S2 and the output pins on the board. The coax shields are only connected at one end: the +1.9-volt bus strip. Another coaxial cable connects R20 to the board, with the cable's center conductor connected between R20's wiper and R21 on the board, and the shield connected to the +1.9-volt bus and the appropriate lug on R20.

The last shielded cable connects J1 (the output jack) to pin 6 of IC5. The shield is used to connect J1's ground lug to the board's ground bus. Cut the five cables to about 8 inches and install them on the board. Once all of that is done, double check all the component connections, and pay particular attention to component polarities. Use a magnifier to check for cold solder joints and solder bridges. When satisfied, install IC1–IC5 in their sockets with the proper orientation and set the board aside.

Now turn your attention to the quadruple-output power supply. Like the signal-generating circuitry, the power supply was assembled on a section of experimenter's board. That board, as was the case with the signal-generating board, has a pair of foil buses running down its center. Tie those buses together at several points; they will be used as a ground bus. If a miniature transformer is used for T1, it can be mounted directly to the board. Solder all components directly to the board, including the semiconductors, using short leads. LED1 will be mounted on the front panel. Connect two 6-inch leads to the board—one at the ground terminal and the other at the −5-volt output of the power supply. Those leads will be used to connect LED1 to the board. Connect a 6-inch lead to the board for the five power supply outputs: +12-, −12-, +5-, −5-volt outputs, and ground. Color-coded #22 wire is highly recommended for this operation. Twist all five of the wires together in a bundle. Add another twisted pair of 6-inch leads to the board for the 117-volt AC inputs.

Once the power supply is finished, it's time to select an enclosure in which to house the generator. The author's prototype was housed in a $2^3/_4$- (H) × $5^1/_4$- (W) × 5-inch plastic enclosure. When selecting an enclosure, make sure that there is enough panel space for the panel-mounted components. Once a suitable enclosure has been selected, the next step is to lay out the front panel. Start by determining the location for the slide controls, and then drill four $^1/_8$-inch mounting holes for the potentiometers, spaced $1^3/_4$-inch apart vertically, and $^9/_{16}$-inch apart horizontally. Cut an $^{11}/_{16}$- × $1^1/_2$-inch rectangular hole centered between them. That clears the way for both of the slide control arms. To hide the large cutout, a bezel can be fabricated from thin, flexible sheet of plastic. The author used $1^3/_4$ (W) × $2^1/_{16}$ (H) × $^1/_{32}$-inch (thick) section of clear plastic that was mated with a file card cut to the same size. Mounting holes corresponding to the four $^1/_8$-inch mounting holes were drilled in the front panel for the potentiometers.

Once the bezel has been cut to the proper size, drill four $^3/_{32}$-inch holes $^9/_{16}$-inch apart horizontally and $1^1/_2$-inch apart vertically centered between the four $^1/_8$-inch bezel-mounting holes. Lay a metal straightedge along the outside edges of two of the $^3/_{32}$-inch holes spaced at $1^1/_2$ inches. Using a hobby knife, cut away the $^3/_{32}$ × $1^1/_2$-inch piece of material between the two $^3/_{32}$-inch holes, forming a slot. Repeat the procedure for the other pair of holes. The slots allow full movement of the control arms. For best results, drill and cut the entire bezel at the same time. When that's complete, prepare a multiplier scale on the file card part of the bezel. The scale is composed of 20 index lines, with each line spaced $^1/_{16}$-inch apart. That gives a total scale length of $1^3/_{16}$-inches, which is equal to the "throw" of the slide potentiometers specified. The 20 lines indicate multiplier factors of ×0.1–×2.0.

Now comes the tricky part—ganging the two slide-control arms. There are several ways of accomplishing that feat. One method is to simply glue two standard slide control knobs together. Other methods of accomplishing that task include drilling a hole through each slide arm and connecting them with a $^1/_2$-inch spacer, or to fabricate a custom dual-slide knob as the author did.

Figure 3 outlines how the author handled custom-knob fabrication. Starting with a bar of plastic or aluminum about $1^1/_{16}$-inches long and $^1/_2$–$^3/_8$-inch square, drill two holes $^9/_{16}$-inch apart (centered on the bar) and $^3/_{16}$-inch deep, using a #7 (0.201-inch) bit. Drill another hole

PARTS LIST FOR THE E.Z. SIGNAL GENERATOR

SEMICONDUCTORS

BR1—1-amp, 100-PIV, full-wave bridge rectifier
IC1—LT1016 ultra-fast comparator, integrated circuit (Linear Technology)
IC2—LF351 JFET op-amp, integrated circuit (National Semiconductor)
IC3, IC4, IC5—LM6361 high-speed op-amp, integrated circuit (National Semiconductor)
IC6—78L12 positive 12-volt, 100-mA, fixed- voltage regulator, integrated circuit
IC7—78L05 positive 5-volt, 100-mA, fixed-voltage regulator, integrated circuit
IC8—79L12 negative 12-volt, 100-mA, fixed-voltage regulator, integrated circuit
IC9—79L05 negative 5-volt, 100-mA, fixed-voltage regulator, integrated circuit
LED1—Light-emitting-diode, any style or color

RESISTORS

(All fixed resistors are 1/4-watt, 5%, carbon-film units.)
R1—180-ohm
R2—220-ohm
R3—200-ohm
R4—330-ohm
R5, R9—1500-ohm
R6, R10, R23—5000-ohm, single-turn trimmer potentiometer
R7, R13—27-ohm
R8, R14—500-ohm, linear-taper, slide potentiometer, 30mm (Mouser #312-9100-500)
R11, R15, R16, R17—3900-ohm
R12—100,000-ohm, single-turn, trimmer potentiometer
R18—100,000-ohm, multi-turn, cermet, trimmer potentiometer
R19—1-megohm
R20—500-ohm, panel-mount, linear-taper potentiometer
R21—1000-ohm
R22—12,000-ohm
R24—10,000-ohm
R25—390-ohm

CAPACITORS

C1—0.001-µF, monolithic-ceramic
C2, C5, C22–C27, C44, C45—1-µF, 25-WVDC, solid-tantalum electrolytic
C3, C4, C6, C20, C28–C37, C42, C43, C46, C47—0.1-µF, monolithic-ceramic
C7, C16—150-pF, 5%, mica
C8—47-pF, 5%, mica
C9—500-pF, 5%, mica
C10—0.005-µF, 5%, polyester
C11—0.05-µF, 5%, polyester
C12—0.47-µF, 5%, polyester
C13—0.03-µF, 5%, polyester
C14—22-µF, bi-polar, electrolytic (Mouser #140-BPRL5OV22)
C15—2–25-pF (or nearest value) trimmer
C17—0.0015-µF, 5%, polyester
C18—0.015-µF, 5%, polyester
C19—0.15-µF, 5%, polyester
C21—1-pF, ceramic-disc
C38, C39—470-µF, 25-WVDC, aluminum electrolytic
C40, C41—10-µF, 25-WVDC, solid-tantalum electrolytic

ADDITIONAL PARTS AND MATERIALS

J1—Panel-mount female BNC jack
PL1—AC line cord with molded power plug
S1—DP5P panel-mount, non-shorting, rotary switch
S2—SP3P panel-mount, non-shorting, rotary switch
S3—SPST 1-amp, 120-volt AC miniature toggle switch
T1—24-volt, 100-mA, center-tapped, step-down transformer
Experimenter's board (RadioShack #276-168 or similar), low-profile IC sockets, 2 3/4 × 5 1/4 × 5 inch (or larger) plastic enclosure, knobs, spacers, #22 bus wire; #22 stranded hook-up wire, RG-174 (or equivalent) coaxial cable, spacers, hardware; solder, *etc.*

Note: All semiconductors are available from: Tech America, P.O. Box 1981, Fort Worth, TX 76101-1981 (Tel. 800-877-0072) or from Digi-Key (Tel. 800-344-4539). All passive components are available from: Mouser Electronics (Tel. 800-346-6873).

into each end of the bar, 1/8-inch from the edge, breaking through the #7 holes, with a #36 (0.106-inch) bit. Tap the two #36 holes with a #6-32 thread tap. Install a #6-32 × 1/4-inch set-screw in one hole, and a #6-32 × 1/2-inch set-screw in the other hole. The 1/2-inch screw acts as the scale indicator. To use the knob, the control arms of the potentiometers must be cut so that when mounted they extend 7/16-inch from the front panel. Dry fit the potentiometers, bezel, and knob to the front panel to check for smooth operation. The knob's set-screws must be locked tight. Once you're satisfied, remove the assembly.

Next, locate and drill the mounting holes on the front panel for S1, S2, R20, J1, and LED1. Label the front panel as needed. After that, drill holes on the rear panel of the enclosure for a line cord grommet or strain relief and the power switch.

Connect 1/2- or 3/4-inch spacers to the corners of the signal-generating and power-supply boards. Dry fit the panel-mounted components to the panels and drop both boards into the enclosure. Shift the boards around to determine the orientation that provides sufficient board clearance, while keeping the leads between the signal-generating board and the panel-mounted components as short as possible. **Note**: The power-supply board and components should be kept separate from the signal-generating board to prevent distortion from entering the signal path. Once the best location has been determined, mark the board locations (using the boards as templates) in the cabinet and remove everything from the cabinet. Drill mounting holes in the cabinet, and permanently install all of the panel components and control knobs.

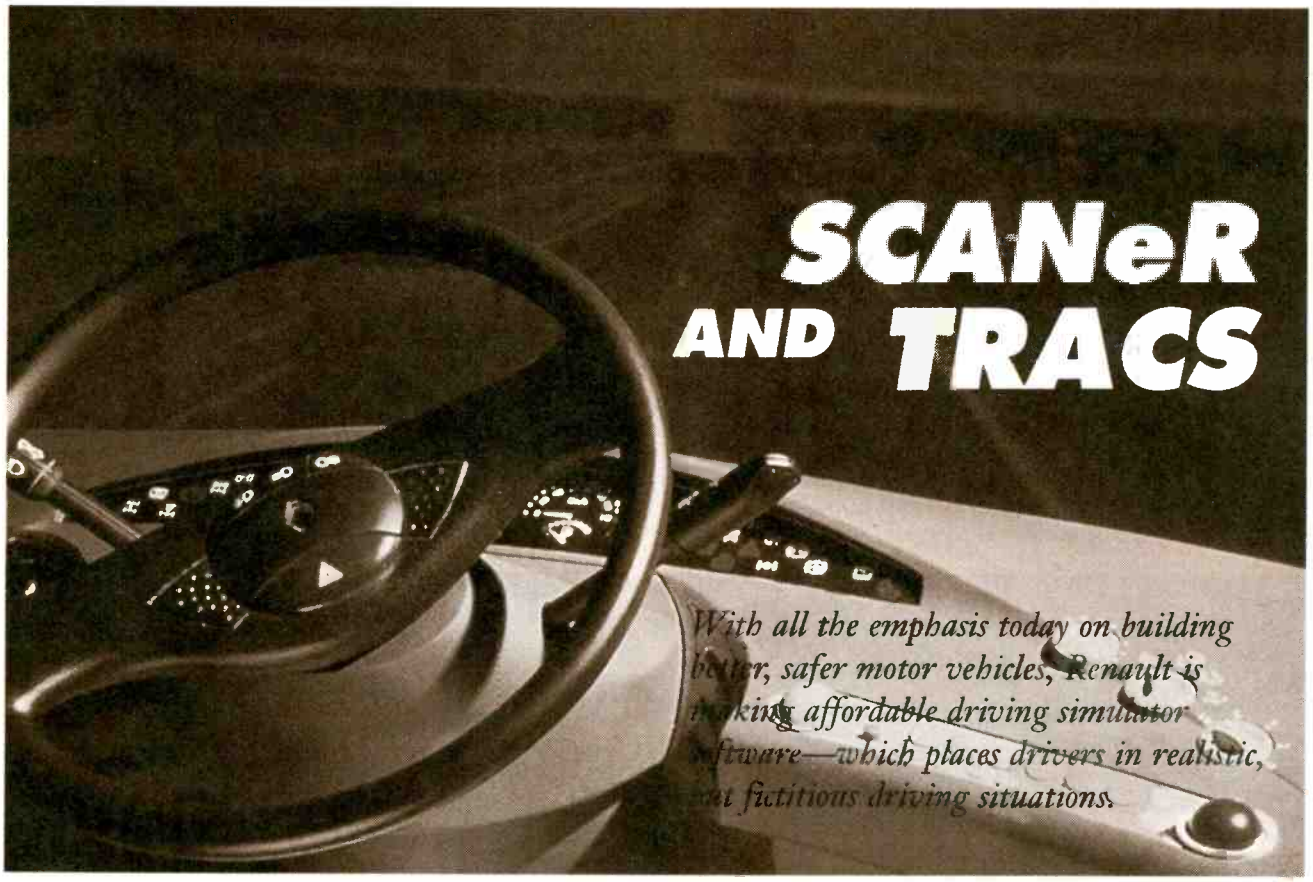
Place the boards (mounted on spacers) back into the enclosure. Connect the panel-mounted components to the circuit board(s), being sure to keep all leads and cables as short as possible. Connect one conductor of a 117-volt AC line cord to the primary of the transformer and the other conductor in series with the power switch and the AC input to the power-supply board.

Connect the five output leads of the power supply to the signal-generating board. The ±12-volt leads should go to the power buses located under IC3–IC5, and the ±5-volt leads should go to the buses located under IC1 and IC2. Connect ground lead to the ground bus.

Then drop the boards back in the cabinet and connect all of the other leads to the panel components. Double check all connections and, once satisfied, permanently mount both boards in the enclosure.

Setup and Calibration. The E.Z. Signal Generator can't be expected to function properly unless it is provided with the proper supply voltages, so check the operation of the power supply first. Using a DVM, check for the proper voltages at the power-supply terminals of IC1–IC5. There should be ±5 volts at

(Continued on page 64)



SCANeR AND TRACS

With all the emphasis today on building better, safer motor vehicles, Renault is making affordable driving simulator software—which places drivers in realistic, but fictitious driving situations.

BILL SIURU

For years flight simulators have been used in the development of new aircraft and in the training of new pilots, as well as maintaining the proficiency of seasoned aviators. Now, driving simulators are being used by automakers like France's Renault in the their quest to develop a safer motor vehicle. However, unlike most other automakers, Renault is marketing its driving simulation software commercially, and it is quite affordable, at least by the standards of sophisticated, interactive software that runs on high-end workstations.

Some may wonder why driving simulators are only now beginning to appear, while aircraft simulators have been around for decades. The reason for the lag is that the challenges for automotive simulators are quite different from those for flight simulators. In addition, aircraft-simulator hardware is not directly transferable to driving simulators, because the feel of a car or truck in contact with the road surface is vastly different from that of an aircraft flying through the air. For that reason, the very expensive hydraulically-actuated platforms used to provide realistic cockpit motion are not directly appropriate for automotive simulators.

Further, because a driver is much closer to objects outside the cab than a pilot in the cockpit is to airborne objects, driving simulators usually have to respond more rapidly to control inputs. Likewise, the visual displays of the outside environment have to be more detailed, realistic, and faster than for an aircraft. Then there is the matter of economics. Because aircraft are much more expensive than cars and trucks, and carry far more passengers, the stakes in terms of both human lives and financial costs are abundantly higher for an aircraft crash as opposed to a highway accident.

SCANeR. Renault, through its software partner, CISI, is now marketing a lower-cost alternative to much more complex and expensive, dynamic-driving simulators. SCANeR—which stands for *Simulateur de Conduite Automobile Normalise en Reseau* and translates to "Standardized Driving Simulator Operating within a Network"—is a software package made up of several independent modules as shown in Fig. 1. Among the modules that make up the package are a real-time driving simulator, a sound generator, a 3D-visual extension, a traffic generator, a configuration interface, and an instructor interface.

To help keep costs down, the driving simulator software is connected to an actual vehicle cockpit. For instance, at the CISI center in Rungis near Paris, the simulator uses a Renault 19 sedan with all the standard features except for an engine. The simulator has also been hooked up to other Renaults, as well as BMWs, Volvos, and Rovers. Inputs from the vehicle to the simulator include the application of the brake and clutch pedal (for manual transmissions), accelerator, steering wheel, and gearbox.

When mounted on a low-cost, electric-motor-driven platform, SCANeR can simulate the motion of a four-wheel vehicle with 15-degrees of freedom—three chassis

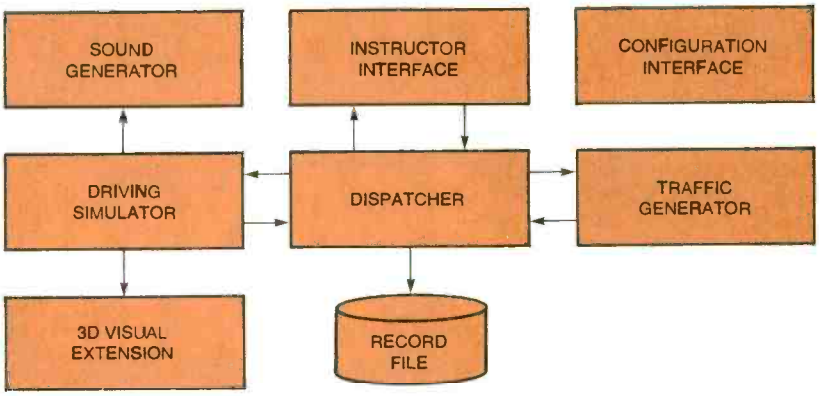
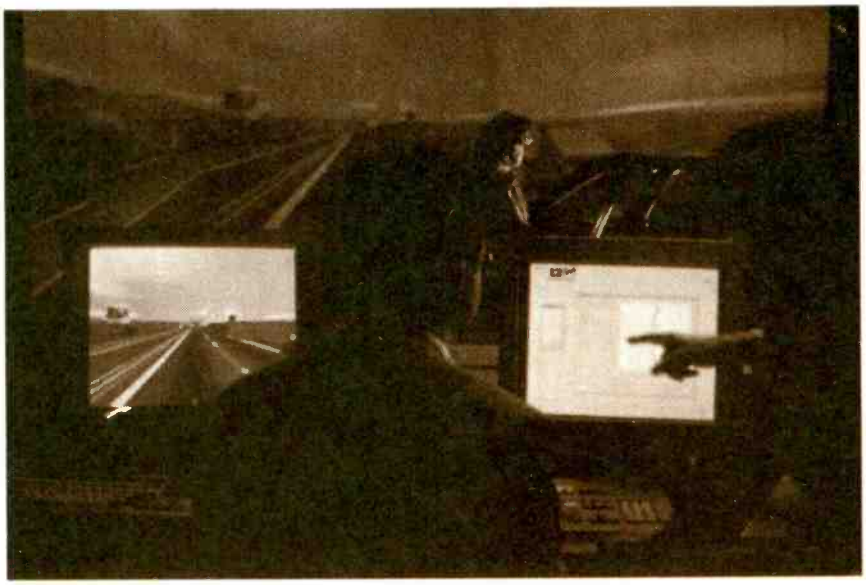


Fig. 1. Renault's SCANeR software package is comprised of several independent modules including a real-time driving simulator, a sound generator, a 3D-visual extension, a traffic generator, a configuration interface, and an instructor interface.



Shown here are the components of the SCANeR 5.0 simulator software package.

Shown here is a view from the Renault 19 in the SCANeR driving simulator.

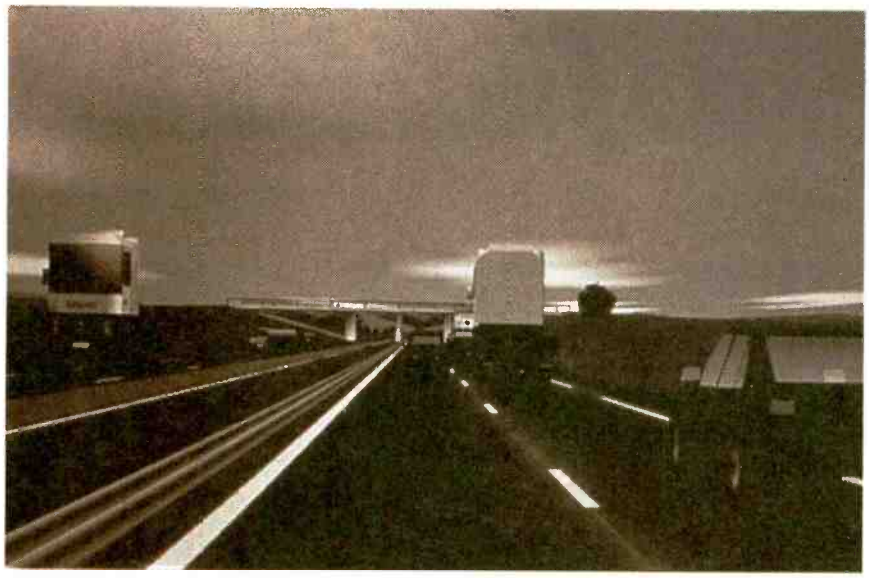
coordinates (x, y, z), three Euler angles (heading, pitch, and roll), four vertical wheel translations, four wheel speeds, and engine rpm. SCANeR can also simulate skids by modeling the contact between the tires and road.

SCANeR uses real-time, computer-generated images to place the driver in a realistic, but fictitious driving situation. For example in the CISI simulator set-up, three images are projected from three different angles to provide a 140° view of the road. The software also provides special effects, including nighttime driving, fog conditions, and traffic signals. Graphic cards can be added to improve the texture and realism of the computer-generated images. SCANeR also produces sound effects that include the engine at different rpm rates, rumbling and tire sounds, surrounding traffic, a gong or horn, and even a crashing windshield.

When interfaced with a traffic generator, SCANeR can control about 50 surrounding vehicles. Scenarios can include driving in file, lane changing, merging and passing, navigating intersections, and toll payment. The basic SCANeR 5.0 car driving simulator costs 80,000 French francs (about $16,000). For the full package with all the options added, the bottom line is 250,000 francs (about $50,000)

SCANeR has already been used for several applications. One of the first users was the Transport Research Laboratory in England for research into traffic engineering, design, ergonomics, and road safety studies. SCANeR has also been used to evaluate various intelligent vehicle/highway technologies, like obstacle detection, distance control, and vehicle-to-infrastructure communications, as well as to study new instrument-panel layouts. Possibilities in driver-behavior research include the effects of drugs, tiredness, sleepiness, and the way disabled drivers drive.

TRACS. By now, truck drivers in Europe have begun to train on TRACS (*TR*uck *A*nd *C*oach *S*imulator)—a SCANeR technology that has been developed as part of the European EUREKA intelligent high-



Realistic traffic images are generated by the SCANeR software. Note that the road display, aside from the usual frontal view of traffic ahead, also simulates traffic to the side of the vehicle, producing a very realistic driving environment.

Shown here is the TRACS cockpit used for simulated training of professional truck drivers.

ways and vehicles program. The aim of TRACS is to reduce traffic accidents involving trucks through better training for professional drivers.

In France, trucks account for 15% of the fatal accidents, even though they represent less than 2% of the vehicles on the road. Those statistics have to be tempered by the fact that truckers travel many more miles and since trucks are much heavier, fatalities are more likely in car-truck encounters.

TRACS is a sophisticated, interactive simulator that puts the driver in realistic traffic and weather situations. That includes both common driving hazards and those that are rarely encountered in real life, such as a sudden bend in the road, a patch of dense fog, or black ice; the vehicle in front suddenly stopping or changing lanes; or the shifting of the truck's load. TRACS allows drivers to be put into realistic and dangerous situations without putting them in real danger.

With TRACS, the drivers sit in a realistic truck cab with the usual steering wheel, throttle, brake, clutch, instrumentation, and other controls. He or she views the computer-generated virtual scene of the road and other traffic through the windshield. The TRACS' computer database includes several miles of varying roads and adjacent landscapes on which the driver can practice. The instructor, located at a computer workstation, specifies the kind of road and traffic conditions as well as injecting various hazardous situations. Driver's reactions are monitored and recorded for post-session appraisals and critiques.

Both motion and sound add to the realism. The simulator's cab is mounted on a motion platform that is programmed to pitch and roll like a real truck moving down the road, braking, or making sudden lane change maneuvers. Engine and external traffic sounds are fed into the cockpit.

According to Renault, TRACS should cost no more than 1–2 million French francs (about $200,000 to $400,000). Initially, TRACS will be marketed in Europe but could soon come to America.

Virtual Reality Crash Simulation. Besides improving safety through driving simulators, Renault is educating the public about what happens in a crash through its "Insight" technology. Using a computer-generated image of a transparent vehicle, Insight shows from every angle how a car's mechanical parts deform in a collision and what happens to the occupants. The crash is covered from start to finish.

To create Insight, Renault engineers used data from real crash tests to create computer models showing parts being bent out of shape during the accident. The company's designers then gave a realistic appearance to the computer models so they looked more like a real car and a real accident. The entire crash was recorded on film since Renault uses Insight as a demonstration aid that is shown to the public as part of its safety advertisements and education campaigns. ■

FOR MORE INFORMATION

French Technology Press Office, Inc.
401 N. Michigan Avenue, Suite 1760
Chicago, IL 60611
Tel. 312-222-1235
Fax: 312- 222-1237

COMPUTER BITS

Microcontrollers IV

JEFF HOLTZMAN

Atmel Corporation makes a series of microcontrollers known as AVR. I don't think the acronym itself means anything in particular; rather it's supposed to suggest advanced RISC technology. RISC stands for Reduced Instruction Set Computing; the basic idea is to produce simpler, cheaper, faster silicon, and move the complexity to software. At the other end of the spectrum, we have CISC, for Complex Instruction Set Computing. Most reasonable people would agree that an MMX Pentium II is a pretty complex CPU, even if it does have some RISC-like characteristics. Anyway, we're here to talk technology, not semantics.

The past few months, we've been talking about microcontrollers. We started off looking very briefly at the market-leading PIC series of devices. However, I quickly realized that by this point in time, that bone has been "picked" pretty clean. Conversely, the AVR series is new, there is not that much general knowledge floating around about it, and it has some pretty cool capabilities, including significant quantities of on-board flash and EEPROM, pulse-width modulation output, A/D input, sleep modes, low power consumption, and more.

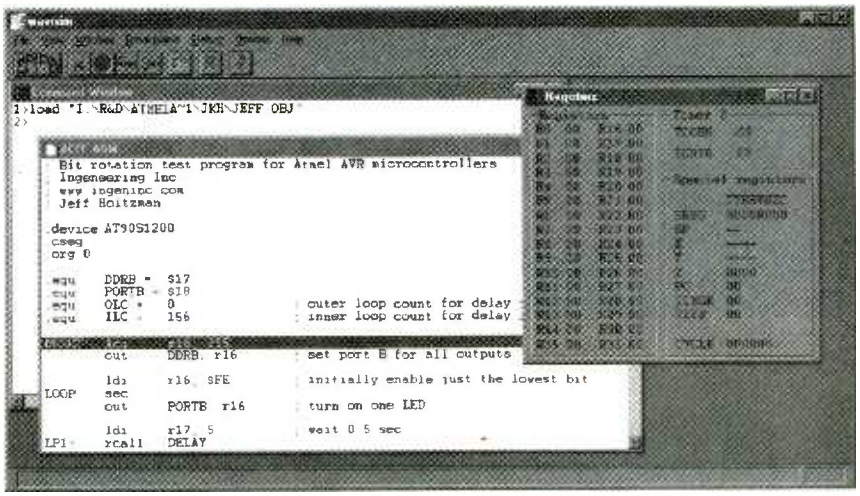
In last month's column, we looked at a specialized version of Atmel's low-end *AT90S1200*, a device called the *MV1200*, which contains a built-in BASIC interpreter. The BASIC has some attractive features, but the supporting tools are poor. Perhaps they'll improve. Regardless, the 1200 pretty much begs for assembly-language programming to get maximum effect from the chip. So, this time we'll start attacking the beast directly.

GETTING STARTED

To get started with AVR, you need several items:

- Some AVR chips;
- An AVR programmer/downloader;
- Development software (text editor, assembler); and a
- Development system (PC).

I'm assuming you've already got



Atmel's AVR simulator allows you to run and debug code, including source-level tracing, and single-stepping, in a Windows environment. Works fine under NT.

item 4. You can pick up the other items for under $50 as part of an evaluation kit. As for the development software, there is a command-line (DOS) assembler and device programmers, and a Windows-hosted assembler, debugger, simulator, and device programmer. All software is available free from Atmel's web site, and it comes with the evaluation board. The web site also has a nice set of application notes showing how to do things like successive-approximate A/D conversion, multiplication and division, device programming, and so on.

THE EVALUATION BOARD

The evaluation board lists for $49. It comes with everything you need to get started, including a device programmer, a serial port (for attachment to the PC), the development software, and a sample 1200 chip. The board can handle the low-end 20-pin devices, as well as the high-end 40-pin devices like the 8515. The sockets are nested and wired in parallel, so only one device may be used at a time.

The board comes with eight small SPST momentary switches, eight small LEDs, and some 0.1-inch dual-row male connectors that allow you to route signals from the device's I/O pins to the switches and LEDs, or to external devices. There are separate connectors for all five ports supported by the high-end device, and the kit comes with two ribbon jumper cables for connecting up the switches and LEDs.

The board has on-board intelligence, an Atmel 89C2051, which, ironically, is a member of the 8051 family of microcontrollers. (Wouldn't it have made more sense to use a 1200? That way the board could program its own

(Continued on page 48)

VENDOR INFORMATION

Atmel Corporation
2325 Orchard Parkway
San Jose, CA 95131
Tel. 408-441-0311
Web: *www.atmel.com*
Part Numbers:
AT90S1200-16PC is the 16-MHz 1200 in a 20-pin DIP package.
AT90S8515-8PC is the 8-MHz 8515 in a 40-pin DIP package.
ATMCU00100 is the evaluation board.

Arrow/Schweber Electronics
Tel. 800-833-3557

Marshall Industries
Tel. 800-833-9910
Web: *www.marshall.com*

Pioneer Standard Electronics
Tel. 216-587-3600
Web: *www.pios.com*

The G5RV Antenna Revisited

JOSEPH J. CARR, K4IPV

The properties of the G5RV antenna (Fig. 1) have been a controversial topic for quite some time. Supporters wax ecstatic when talking about their "all-band" G5RV. Critics claim it doesn't work...although what is lacking in their accounts is evidence that they've ever built one. I suspect that the truth lays somewhere between. It is highly unlikely that any antenna has universal application. I firmly believe that anything that is everything to everybody is nothing to anybody. Thus, I am convinced that the G5RV is, like other antennas, fine for some purposes and not for others.

One reason for controversy is the originator of the antenna. The name "G5RV" is the callsign of the claimed originator, Louis Varney, a British ham operator. Others claim that the G5RV antenna is nothing but a 1930s or 1940s vintage design by Collins Radio for the U.S. military. However, the similarities between the Collins antenna and the G5RV are, it seems to me, at best a case of "further development" or "co-invention," rather than something else. Because of the obvious differences between the two antennas, I prefer to continue to credit Lou Varney for the design.

An American reviewer of one of my antenna books pasted me to the wall for even including the G5RV in the book. He stated that he "...wish(es) the G5RV antenna would just go away." The same reviewer stated that it would be better to just put up a "...dipole of the same size." Wrong! The dipole is a single-band resonant antenna, where the G5RV will work on several harmonically related bands. The G5RV may have two poles, but it doesn't exactly fit into the same category as the half-wavelength dipole. Perhaps the "NIH syndrome" (Not-Invented-Here) affected this reviewer, not technical excellence. The G5RV antenna is, after all, more popular in Europe than in the United States and its inventor is European. In my own experience, the G5RV tends to be built in the U.S. by antenna experimenters, and most of those whom I've talked to are happy with the results.

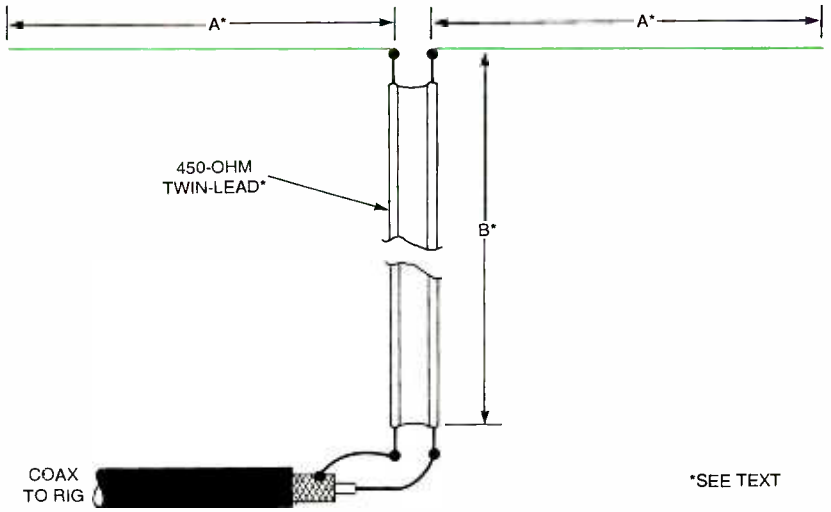


Fig. 1 G5RV antenna structure.

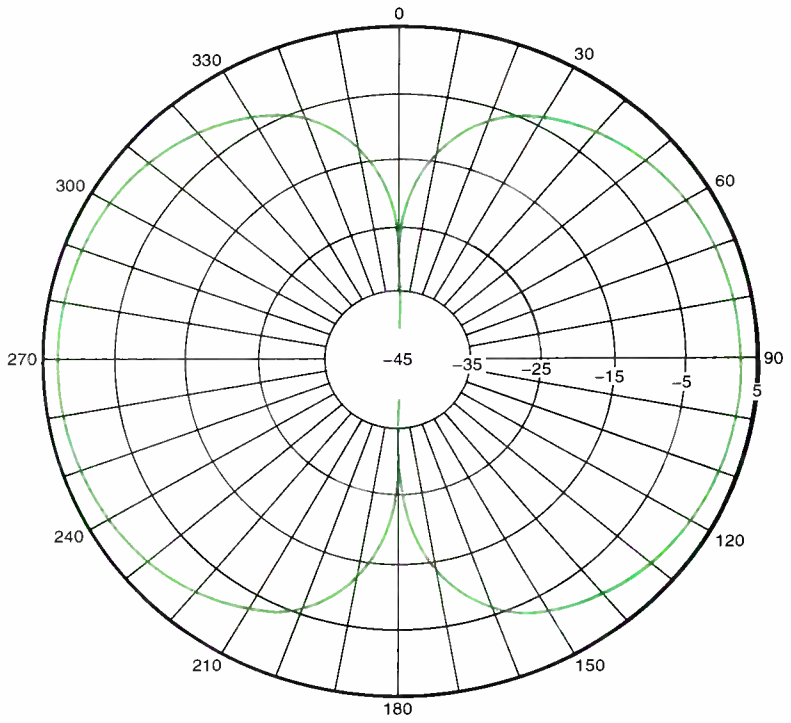


Fig. 2. Azimuthal pattern at 3.5 MHz.

CONSTRUCTION OF THE G5RV ANTENNA

The G5RV antenna looks like a dipole, to be sure, but its length at the design frequency is considerably longer. Unlike many multiband antennas, the G5RV is not cut to the lowest frequency of operation, but rather at a mid-band frequency. For a high-frequency multiband ham band antenna (3.5–28 MHz), one designs it for 20 meters (14 MHz).

Like the dipole, the G5RV is fed in the center. Unlike the dipole, a matching section made of 450-ohm or 300-ohm twin-lead transmission line (450 ohm is highly preferred to reduce line losses) is connected between the antenna feedpoint and the 75-ohm coaxial cable. The length of each radiator element ("A") is:

$$A = 728/f_{MHz}$$

While the length of the 450-ohm twin-lead matching section is

$$B = 480 \times V/f_{MHz}$$

where "A" is the length of each radiator element in feet, "B" is the length of the 450-ohm matching section in feet, f_{MHz} is the middle frequency in the band of operation, and "V" is the velocity factor of the matching section line (typically 0.82 for twin-lead and 0.99 for open-wire parallel line).

In case you don't like to do arithmetic, the calculations are already done for the HF ham bands (f_{MHz} = 14.15 MHz): A = 52-feet (2A = 104 feet overall), and B = 34 feet for open-wire transmission line or 27.5 feet for 300-ohm or 450-ohm twin-lead. There is some argument over these figures (various lengths have been published), but these measurements are regarded by many hams who have actually used the antenna as a good trade-off.

The VSWR on each band is a bit different, and the use of a transmatch or similar coax-to-coax antenna tuning unit between the transmitter and the input to the coaxial cable transmission line is recommended.

There is a possibility of an unbal-

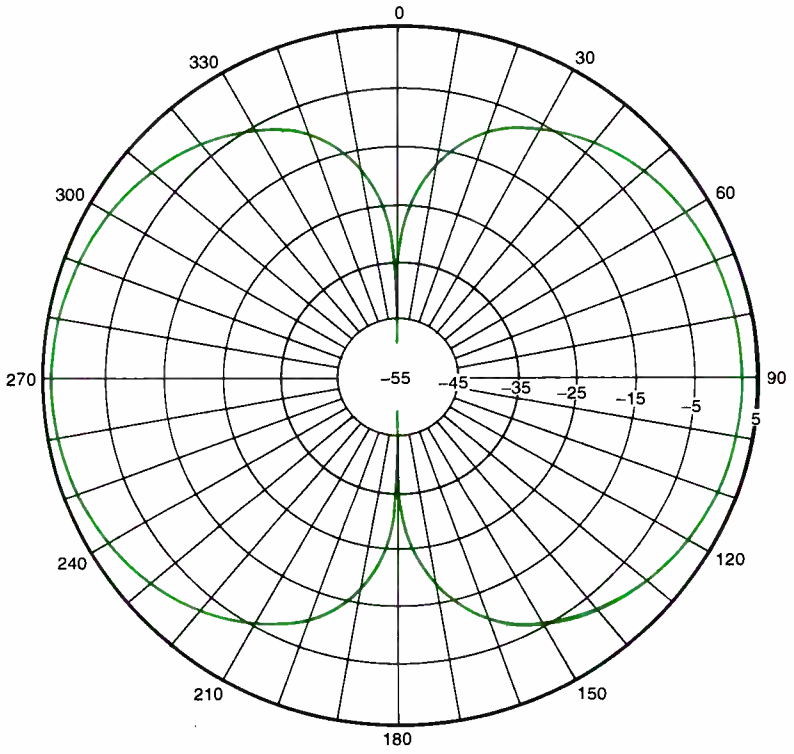


Fig. 3. Azimuthal pattern at 7 -MHz.

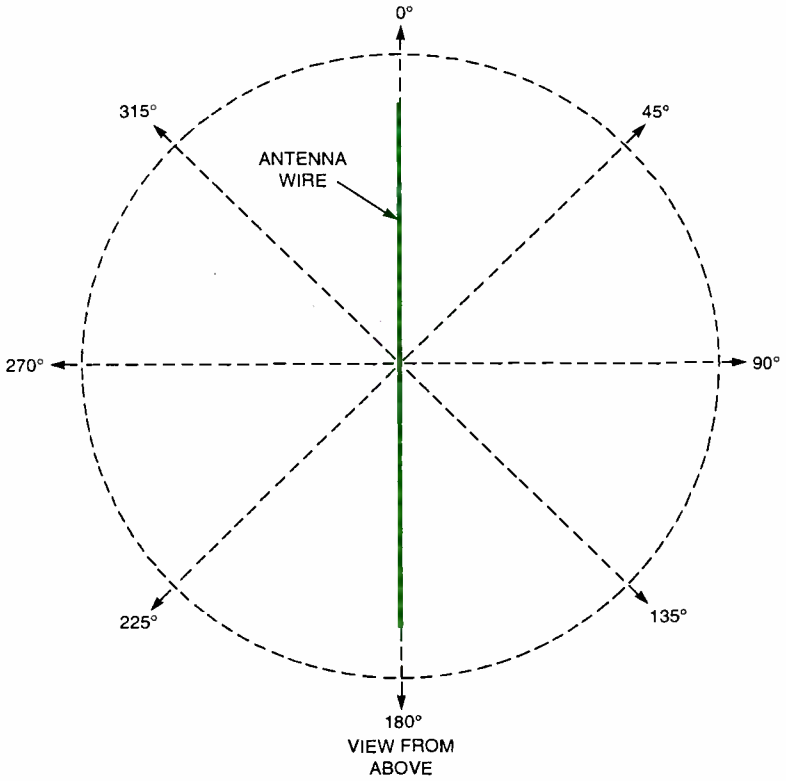


Fig. A. Coordinate system used for azimuthal patterns.

COORDINATE SYSTEM FOR ANTENNA PATTERNS

The antenna modeling software that was used is based on the NEC-2 system, and allows wires to be positioned in a three-dimensional (XYZ) Cartesian coordinate space. When viewed from above, the angles are as shown in the figure. The antenna wire is run from 0° to 180°. For dipoles, this means the nulls will be at these angles. The main lobes of the figure-8 dipole pattern would be along the 90° to 270° line. (See Fig. A.)

anced line condition existing that causes some radiation from the feedline for transmitters that can cause TVI and other forms of unpleasantness. The solution to this problem is to wind the coaxial cable transmission line into an in-line choke at the point where the coax connects to the twin-lead or parallel line matching section. This is done by winding the coax into a 6-inch diameter coil of ten turns right at the feedpoint. The coiled coax can be secured to the center insulator with tape, string, or some other mechanism.

If you want more technical details on the G5RV antenna, see For More Information. Varney's article gives the basis for operation of the G5RV antenna across the ham bands 3.5 MHz through 28 MHz.

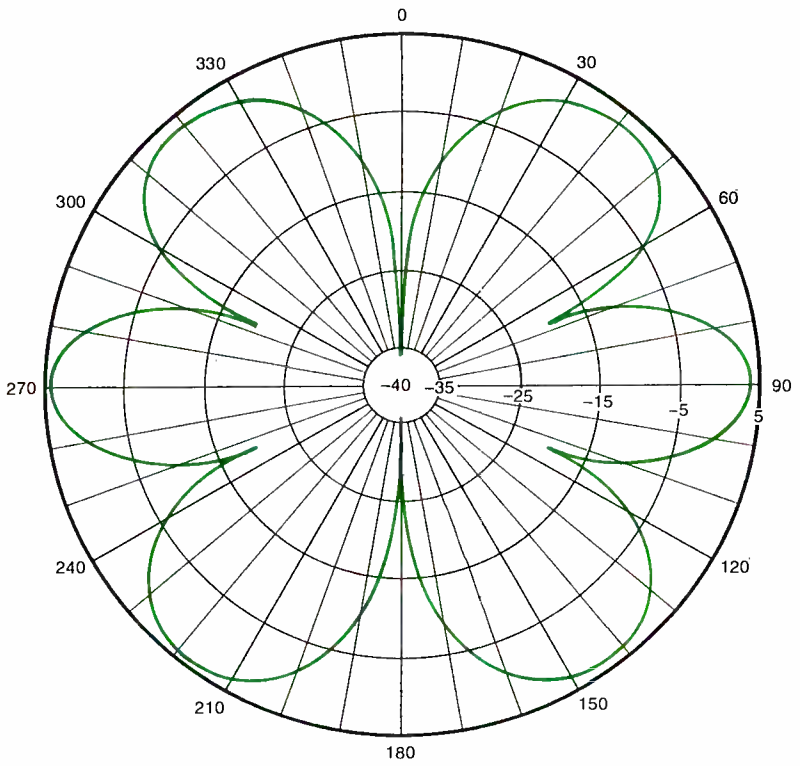


Fig. 4. Azimuthal pattern at 14 MHz.

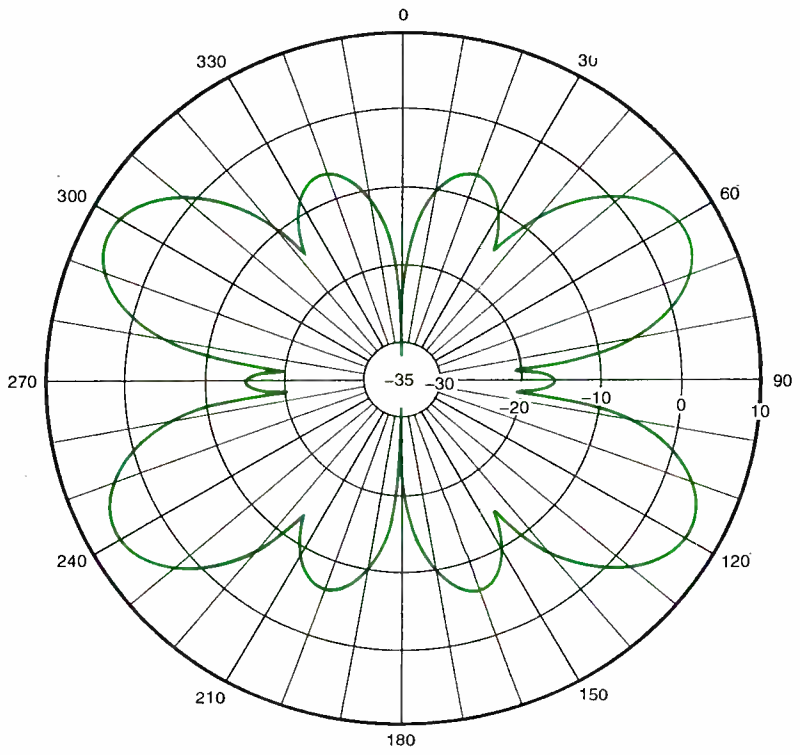


Fig. 5. Azimuthal pattern at 21 MHz.

G5RV PATTERNS

One way to look at any antenna is to examine its radiation patterns. In the accompanying figures we will take a look at the azimuthal radiation patterns of an "ideal" (free space) G5RV antenna, on the various ham bands from 3.5 MHz (75/80 meters) to 28 MHz (10 meters), using an antenna-modeling program.

The G5RV antenna analyzed is about 104-feet long in total length, so it is nearly one-half wavelength on the 75/80-meter band. It is therefore no surprise that the pattern on 3.5 MHz (Fig. 2) is very much like that of the half-wavelength dipole. Although the shape of the two major lobes is a bit different, the overall patterns are very similar. The "figure-8" pattern has two maxima lobes that are perpendicular to the direction of the antenna (*i.e.,* if the antenna runs north-south, the main lobes are east-west). There are also deep nulls along the line of the antenna (*i.e.,* if the antenna runs north-south, then the nulls are to the north and south).

Interestingly enough, the pattern at 7 MHz is nearly the same (Fig. 3). Perhaps it is because the antenna is somewhat longer than the 7-MHz dipole. An antenna that is 104-feet long is resonant on 4.5 MHz, which is between the two bands. Although not shown, the pattern does not change appreciably at 10.1 MHz—still similar to the dipole doughnut.

A different pattern emerges on the 20-meter band (14 MHz), as shown in Fig. 4. I call this the "scallop pattern" after the food item one finds at seafood restaurants (and which might actually be segmented eel off-season!). This pattern develops four major lobes and two minor lobes, although it can be argued that the minor lobes are almost as strong as the main lobes. This antenna has deep nulls off the ends (0° and 180°), the same as it

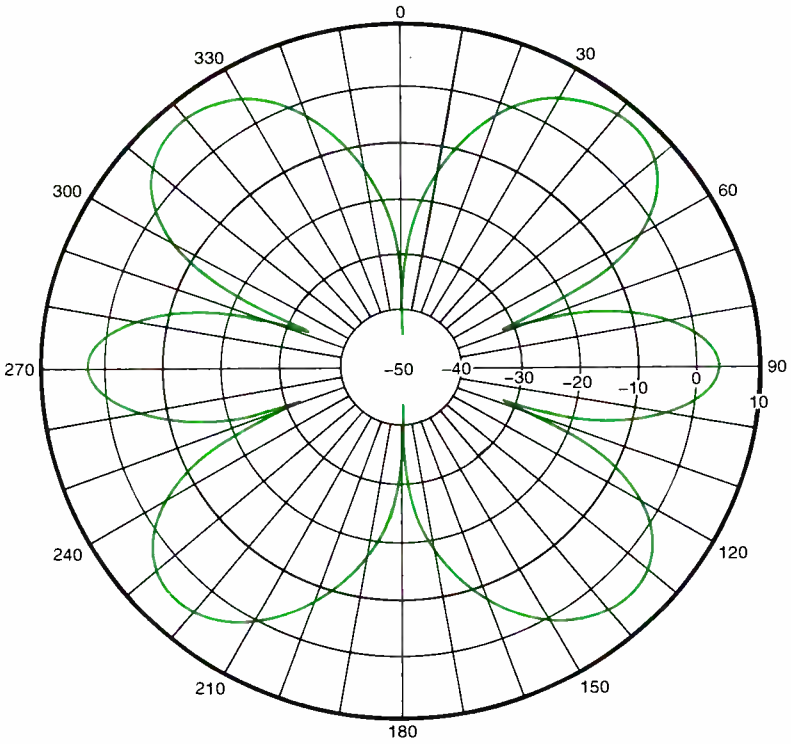


Fig. 6. Azimuthal pattern at 28 MHz.

does at 3.5 MHz and 7 MHz, but also shows shallow nulls at 70°, 110°, 250°, and 290°.

The pattern at 18.5 MHz (figure omitted) is a four-leaf clover showing four major lobes spaced at 60°, 120°, 240°, and 300°. Deep nulls have switched 90° and now appear at 90° and 270°, with shallower nulls at 0° and 180°. When you get to 21 MHz, the pattern really blossoms out (Fig. 5), with four main lobes, four minor lobes, and two really tiny lobes.

FOR MORE INFORMATION

The ARRL Antenna Compendium, Volume 1
American Radio Relay League
225 Main Street
Newington, CT 06111
Tel. 888-277-5289 (orders)
Web: *www.arrl.org*
Price: $10 plus shipping

"The G5RV Multi-Band Antenna" by Louis Varney. Published in July 1984, *Radio Communications.*

This Radio Communications issue is out of print. The magazine is now called RadCom and is published by the Radio Society of Great Britain (RSGB) in the United Kingdom. Libraries may still have the issue available for viewing or on microfilm.—Editor

At 24.5 MHz (figure omitted), the pattern has four main lobes spaced at ±30° from the antenna wire run. There are six minor lobes, arranged such that two are perpendicular to the antenna wire (90° and 270°), and four are arranged at ±22° from the perpendicular line.

When you get to 10 meters (28 MHz), the pattern is a version of the scallop pattern, as shown in Fig. 6. The four main lobes appear at ±50° from the antenna wire run, and minor lobes at ±90° from the wire run.

So there you have it. Over the last 40 years, the G5RV antenna has become one of the most widely used general-purpose multiband HF antenna in the ham community. Its good performance, low cost, modest size, simplicity and versatility are the reasons for this popularity. Comments? I can be reached by snail-mail at P.O. Box 1099, Falls Church, VA, 22041, or by e-mail at carrjj@aol.com. ■

COMPUTER BITS

(continued from page 44)

firmware updates. Why do they do things like this?) The 89C2051 handles communications with the host device, and performs serial-mode programming of user devices. Source for the 89C2051 is readily available.

The evaluation board has separate reset switches for both its brain and the user device, and it has a single 4-MHz crystal and appropriate capacitors connected to the 20- and 40-pin user sockets. The board contains a power switch and on-board regulator, and comes with a power connector. You can plug in just about any "wall-wart," or just use a 9-volt battery with the included power cable adapter. The evaluation board also has two reset switches, one for the 89C2051, the other for the user device, and space for an additional 9-pin RS-232 port.

GETTING YOUR HANDS ON ONE

Purchasing the board and AVR chips has turned out to be easier than I expected. You can check with Atmel's web site for listings of dealers in your area. Major national vendors like Marshall, Pioneer, and Arrow/Schweber carry Atmel. Arrow/Schweber has a toll-free line for small end-user orders, with a $25 minimum. From Marshall, I picked up the evaluation board, two 8515s ($12 each), and half a dozen 1200s ($3 each) for a total of about $110, which included tax and overnight shipping. The official part numbers appear in the sidebar.

When you place your order, get them to throw in a copy of the *AVR Enhanced RISC Microcontroller Data Book*. It has detailed specs on the initial four members of the family, and a detailed reference guide to all assembly language instructions. My copy is dated May 1997 and is marked preliminary; hopefully yours will be more recent vintage. (The evaluation kit also comes with a CD containing all documentation in PDF format.)

Incidentally, I ran across an Atmel document listing a total of eleven devices in the family, ranging from the lowly 1200 to the high-end Mega103, which includes 128K of flash, 4K of EEPROM, 4K of SRAM, an 8-channel 10-bit A/D converter, and more. The document claimed that Mega103 production was scheduled for the first quarter of 1998.

Next time we'll write some assembly language programs to test the evaluation board and start getting used to the tools. Contact me at jeff@ingeninc.com. ■

DX LISTENING

QSL Cards

DON JENSEN

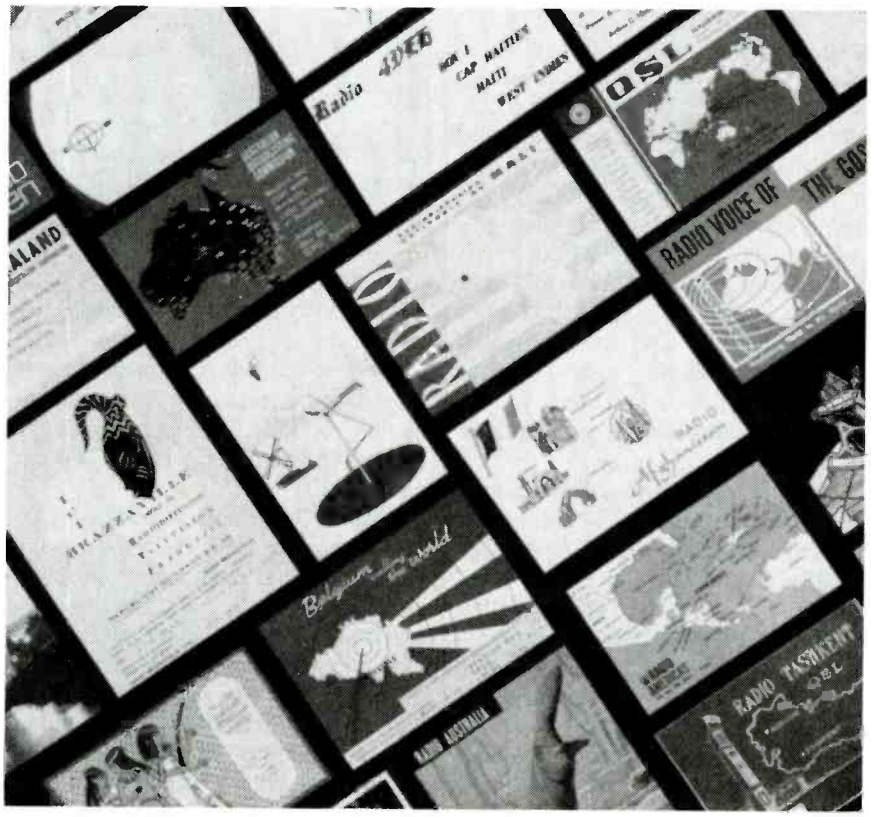
"You mention QSLs, or verification cards occasionally in *DX Listening*," writes Ron Skrypchek of Kearney, NE. "How about telling us more about what they are and how to get them?"

QSL cards or letters sent by radio stations to listeners who report reception have a long history in the listening hobby. When the first regularly scheduled AM radio stations went on the air in the early 1920s, they immediately wanted feedback from their audiences. How well and, indeed, how far were their signals reaching? How did listeners like the programs? Please write and tell us, these pioneer stations asked.

For many, many Americans in those days before coast-to-coast radio networks, it was a thrill to hear a weak and wavering signal all the way from, say Pittsburgh, PA or Schenectady, NY. And so listeners were happy to write to stations to report their receptions. The stations responded with thank you postcards, acknowledging the reports and confirming that, yes, indeed, you heard our signals. These came to be called QSL cards or QSLs, based on an earlier telegraphers' "Q" code, in which QSL signified an acknowledgment.

The practice was well established when SW broadcasting began in the late 1920s, and when signals from Hilversum, Holland, and Daventry, England were heard in North America. They offered even more distant radio reception to the SWL.

Since those early days, many SWLs have collected QSLs as tangible souvenirs of their receptions. For some it is a way to measure progress in the listening hobby. How many stations have I logged? How many countries?



A sampling of QSL cards from a number of SW broadcasters around the world. (Courtesy of Universal Radio Inc., Reynoldsburg, OH).

Today, it is true, the practice of QSLing shortwave stations has faded a bit. Increased costs have led some stations to abandon sending acknowledgments to listeners who write in. Some listeners, too, have stopped writing stations for QSL replies because of higher postal costs. Still, many SWLs do continue to write reception reports and most international broadcasters still respond with QSLs. It's a tradition thing!

If you want to get with the DXer's tradition, start by sending a few reports to stations you hear. A reception report is just a letter to the station informing the staff that you heard its programs. It should contain information about the date and time of your listening, and the shortwave frequency to which you were tuned.

When reporting reception of most of the major international broadcasters, times of listening should be reported in Universal Coordinated Time (UTC), or Zulu (Z)-time as the military say, a worldwide time standard using the 24-hour clock system, in which 1 AM is 0100 and 1 PM is 1300; 11 AM is 1100 and 11 PM is 2300. UTC is equivalent to Eastern Daylight Time + 4 hours (or CDT+5 hours; MDT+6 hours; PDT+7 hours. (In each time zone, add an additional hour in the winter when daylight savings time is not in effect.)

For example, if you live in Philadelphia and are listening to a certain station at 10:30 PM EDT, Saturday, July 4, it should be reported as 0230 UTC (10:30 + 4 hours) early Sunday morning, July 5. Remember to make the reception date you report corre-

CREDITS: Brian Alexander, PA; Jerry Berg, MA; Jim Clar, NY; Peter Costello, NJ; David Krause, OH; Marie Lamb, NY; William McGuire, MD; Mark Mohrmann, NY; Ed Newbury, NE; Jay Novello, NC; Chuck Rippel, VA; Betsy Robinson, TN; John Sgrulletta, NY; North American SW Association, 45 Wildflower Road, Levittown PA 19057; World DX Club, c/o Richard D'Angelo, 2216 Burkey Drive, Wyomissing, PA 19610.

spond with UTC time.

Also include in your QSL reception report a description of the listening conditions, including any interference that disturbs your reception. Include, too, a brief description of the programs you heard. Station personnel also like to know if you enjoyed the programs.

Finally, politely request a QSL card acknowledging and confirming your report. Many SWLs display these often colorful responses on the wall or a bulletin board near their shortwave radio, or in a photo album. Some other things to remember. Approach QSLing with the right attitude. No station *owes* you a QSL. Those stations which beam English-language programs to North America usually will reply. They want your goodwill because you are part of the audience they want to tune in regularly. A polite please and thank-you-in-advance works better than a brusque "gimme."

How do you know where to mail your reception reports? I recommend *Passport to World Band Radio*, (or PWBR), an annual publication available at most larger book store chains (or contact the publisher, International Broadcasting Services Ltd., Box 300, 825 Cherry Lane, Penn's Park, PA 18943; Tel. 215-794-3410, or via its Website: *www.passport.com*). Besides very complete station schedules and interesting features about SWLing, PWBR includes a full listing of station postal and e-mail addresses.

If you haven't been collecting QSLs from the shortwave stations you hear, now is the time to get started. You'll find it a lot of fun.

IT'S CHILE TODAY

Well maybe not if you look at the thermometer, but perhaps if you are looking for DXing targets from this far southern South American country. I came across an interesting list of Chilean shortwave stations compiled by Argentine DXer Gabriel Ivan Barrera during a visit to Chile. This listing appeared in the *Journal of the North American SW Association's* bulletin.

These shortwavers broadcast in Spanish, of course. Most can be logged in North American under the right conditions:

Radio Santa Maria—Broadcasts from Coyhaique on about 6030 kHz, with 10-kW power, from 0900 UTC (from 1000 UTC on Sundays) to 0300 UTC. During part of its schedule, the station relays medium-wave Radio Chilena on 660 kHz, so you sometimes may note that station's ID announcements. You may find this one with live soccer broadcasts on Sundays from about 2000 UTC.

Radio Patagonia Chilena—This station also is located in the city of Coyhaique and broadcasts on 6080 kHz, with just a 1-kilowatt SW transmitter. The low power and irregular schedule, caused by financial difficulties, may make this one harder to hear. On weekdays, it is nominally scheduled to sign on at 0900 UTC (may vary to 0930 UTC) and leave the air the next morning at 0300 UTC. On Sunday, the nominal schedule starts an hour later and ends an hour earlier than the rest of the week. It often relays an FM outlet, Radio Zero in Santiago, receiving those signals via satellite.

Radio Esperanza—This SW station operates from the city of Temuco on 6090 kHz, with 10-kilowatts of power. It broadcasts 24 hours a day, with an English program from 0630 to 0700 UTC except Saturdays.

Radio Triunfal Evangelica—Operating from Talagante, this station uses a shortwave frequency of approximately 5825 kHz, with a low-powered transmitter of just 50 watts. It has an abbreviated schedule, signing on between 2100 and 2130 UTC and signing off at around 0000 (midnight) UTC, Monday, Tuesday, Wednesday, Friday, and Saturday.

SIBERIA AND MORE

One of the lesser known shortwave operations in Russia is Radiostancia Tikiy Okean, whose intended audience is maritime seamen and navy sailors in the north Pacific. The service airs programs originating from Vladivostok in the Russian Far East. Among the frequencies used around 0815 UTC are 9850 kHz, from a Vladivostok transmitter, and 17570 kHz, relayed from Irkutsk in Siberia. Programming is fed to the Siberian relay by an upper-sideband transmitter at Khabarovsk on the Russian Pacific coast on 10344 kHz. Although programming is all in Russian, look for identification announcements: "Govorit Vladivostok" (Here is Vladivostok) and "Tikiy Okean."

GLOSSARY

AM—Amplitude modulation, a mode of broadcasting, but commonly used to describe stations broadcasting in the regular 540 to 1600 KHz radio band.
DX, DXer—A distant station, or an SWL who hunts distant radio signals.
FM—Frequency modulation, also a broadcast mode, but commonly used to describe stations broadcasting in the very high frequency band, 88 to 108 MHz.
ID—Station identification.
IS—Interval or tuning signal, distinctive for each station.
kHz—Kilohertz, unit of frequency measurement, equivalent to 1000 cycles per second.
Kilowatt—A kilowatt or kW is equivalent to 1000 watts. Unit of measurement of the power of transmitters.
MHz—Megahertz, unit of frequency measurement, equivalent to 1000 kHz, or 1 million cycles per second.
QSL—Card or letter from a station acknowledging and confirming a reception report.
SW, SWL—Shortwave; a shortwave listener.

DOWN THE DIAL

Here are some stations you can tune for on the shortwave frequencies:

ARMENIA—9965 kHz, Voice of Armenia's English transmission from 2125 to 2145 UTC includes news, commentary, a listeners' mail program, and Armenian pop music.

ASCENSION ISLAND—5970 kHz, British Broadcasting Corporation relays its English-language programming from this South Atlantic island at around 0045 UTC. This is just one of the BBC's overseas SW relay sites. Others include relay transmissions from Oman in the Mid-East on 5975 kHz, until just before 2000 UTC, when this frequency shuts down, after listeners are advised to retune to other channels. From the eastern Mediterranean, BBC facilities on Cyprus relay programs in English on 6050 kHz at around 2145 UTC.

BULGARIA—7530 kHz, Radio Bulgaria from Sofia is heard with an English transmission at 2200 UTC, including news, commentary, weather,

(Continued on page 53)

CIRCUIT CIRCUS

Electronic Detectors

CHARLES D. RAKES

This visit we're going to spend some time exploring several electronic detector circuits that can be fun to build, and may prove useful in a future or present project. So get out the junkbox, turn on the soldering iron, and let's make those electrons move!

HIGH-VOLTAGE STATIC DETECTOR

Electrostatic discharge can be a dangerous killer for many of today's high-impedance, solid-state devices. This is especially true for FET and CMOS devices, which can easily be damaged by electrostatic discharge (ESD). Most manufacturers offer grounding procedures to help prevent damage when handling, installing, and working with these sensitive components. A search and destroy (discharge) method can be followed by using an electronic static, or ion, detector to help identify hot spots or danger zones that need neutralizing before installing or operating any of the sensitive devices or equipment.

Let's take a quick look at the composition of an ion or static charge before getting into our detector circuitry. Atoms with an electrical charge are ions. Negatively charged ions have a surplus of electrons and positively charged ions have a deficiency of electrons. Static electricity is generated by adding electrons to an object or subtracting electrons from an object. If the object is well insulated and the surrounding air is very dry, the charge can build to a very high potential. Walking across a carpeted floor or sliding out of a chair can raise a person's potential several thousand volts. That's enough to damage sensitive devices.

The high-voltage detector circuit of Fig. 1 detects the presence and polarity of this static charge, and indicates its relative strength. The detector is actually a dual circuit with one section sensitive to positive ions and the other to negative ions. The positive-ion detector circuit uses three 2N3904 NPN transistors connected in a high-input impedance Darlington DC amplifier circuit.

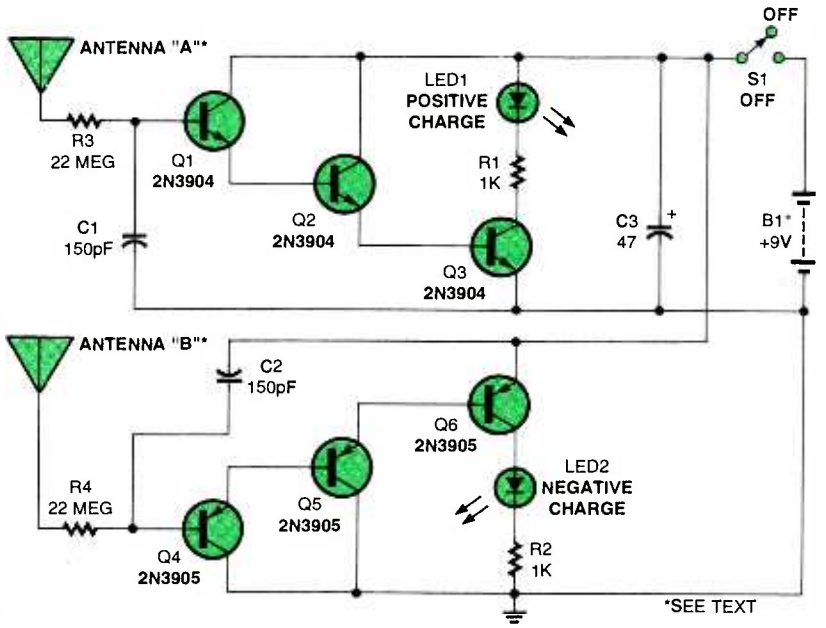


Fig. 1. This neat circuit will detect the presence and polarity of high-voltage static discharge—LED1 lights for positive charge, while LED2 indicates a negative charge.

When antenna "A" is exposed to a positive charge, the relative output is indicated by LED1. The second half of the circuit uses three 2N3905 PNP transistors that are sensitive to negative input charges. LED2 indicates the relative output of the negative charge. Resistors R3 and R4 limit the amplifier's input current, and capacitors C1 and C2 help to keep AC signals from getting into the amplifier circuitry.

Ideally, the static detector will work best if the circuit is enclosed in a metal cabinet, with the battery negative electrically connected to the cabinet. The antennas can be anything from a stiff piece of wire to a collapsible replacement radio antenna. Locate the two antennas so they are about one inch apart and pointing in the same direction. The antennas must not touch each other or the metal cabinet.

When testing out and using the static detector, the cabinet must be at ground potential, so hold the detector or connect it to an earth ground before making checks. Run a comb through your hair and bring it near the antennas. One of the LEDs will light and glow brighter as the comb touches the antenna. Take the detector in hand and move across a carpeted floor and aim the antennas at some fixed metal

PARTS LIST FOR HIGH-VOLTAGE DETECTOR CIRCUIT (FIG. 1)

B1—9-volt transistor battery
C1, C2—150-pF, 100-WVDC mica capacitor
C3—47-μF, 25-WVDC, electrolytic capacitor
LED1, LED2—Light-emitting diode, any color
Q1–Q3—2N3904 NPN transistor (NTE123AP, SK3854, or equivalent)
Q4–Q6—2N3905 PNP transistor (NTE159, SK3466, or equivalent)
R1, R2—1000-ohm, ¼-watt, 5% resistor
R3, R4—22-megohm, ¼-watt, 5% resistor
S1—SPST switch
Metal cabinet, antennas, 9-volt transistor battery, perfboard, *etc.*

object without actually touching it, and observe the LEDs. Without moving, ground out the metal object and repeat the test. If the static charge is completely neutralized, the detector will indicate no charge.

TELEPHONE-RING DETECTOR

Our next entry, Fig. 2, is a telephone-ring-detector circuit. This particular version can be connected to the phone lines without being concerned with the line's polarity—making the installation almost "Murphy-proof."

The normal voltage across most phone lines is about 48-volts DC. The ring detector offers no load to the phone line at any time other than when the phone is actually ringing. The NE-2 lamp doesn't start conducting until the voltage across it reaches about 90 volts. When the neon lamp lights, current flows through R1 and R3, and into the full-wave-bridge circuit, made up of diodes D1–D4. The positive output supplies gate current to the 2N5060 SCR. The SCR turns on, lighting the LED, which remains on until S1 is switched open.

It is best not to use an AC-operated power supply for the ring detector because it is possible that a poorly designed supply could induce an AC signal into the phone lines. That is not a good thing to do, so a good choice for power is a standard 9-volt transistor battery. Before any rings are detected, the current drain from the battery is near zero. After a ring has been detected and placed in memory, the current drain is about 4 mA, so the battery should last a long time.

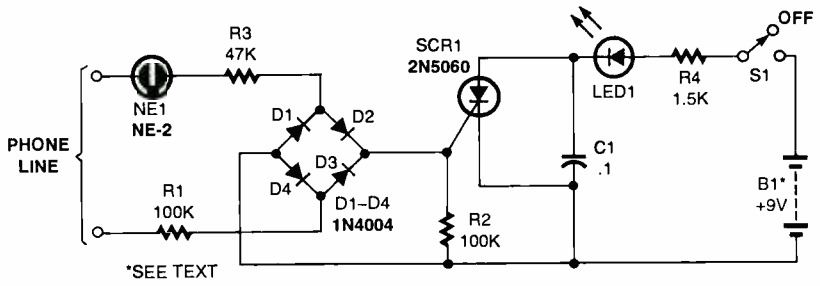


Fig. 2. Need a circuit to detect the ringing of a telephone? This little gem of a circuit will turn on the LED lamp when the phone starts to ring. The LED remains on until the switch is opened

PARTS LIST FOR TELEPHONE-RING DETECTOR CIRCUIT (FIG. 2)

B1—9-volt transistor battery
C1—0.1-μF, 100-WVDC, ceramic-disc capacitor
D1–D4—1N4004 1-amp, 400-PIV, silicon diode
LED1—Light-emitting diode, any color
NE1—NE-2 neon lamp
R1, R2—100,000-ohm, ¼-watt, 5% resistor
R3—47,000-ohm, ¼-watt, 5% resistor
R4—1500-ohm, ¼-watt, 5% resistor
S1—SPST switch
SCR1—2N5060 0.8-amp, 30-PIV SCR (*RadioShack* 276-1067, NTE5400, or equivalent)

AIR-FLOW DETECTOR

Our next entry uses a modified incandescent lamp as the sensing element in an air-flow monitoring circuit. This unusual detecting method is based on the cooling effect of air currents moving over an exposed filament that is operating at a very low voltage. If we measure the filament resistance of a #47 incandescent lamp when cold, it will be on the order of about 4 ohms. Operating at its rated voltage of 6.3 volts and at a current of 150 mA, the lamp's filament resistance is "hot" at about 40 ohms. That is a ten-to-one increase in resistance from cold to hot. By removing the lamp's glass enclosure and exposing the filament to the surrounding air, this hot/cold resistance variation can be used to sense air flow. One of the best ways I've found to break the lamp's envelope without harming the fragile filament is to carefully wrap the lamp in a cloth rag and place it in a vise; then crank the handle until the glass breaks.

Take a look at our air-flow detector circuit in Fig. 3. A 78L05 voltage regulator IC is connected in a constant-current delivery circuit that supplies operating current to the modified #47 lamp, I1. The voltage across I1's filament is monitored by one input of an LM339 voltage comparator IC. The comparator's other input is connected to R5, a 1k potentiometer, which is used as a "sensitivity" control. The comparator's output drives the LED indicator, LED1.

Here's how the air-current detector operates. The detector circuit is set to its maximum sensitivity by adjusting R5 to the point where LED1 just turns on. This preliminary adjustment should take place without any air moving across I1's filament. The comparator's voltage at both inputs of IC2 is very close in value, with the input at pin 4 slightly higher that the voltage at pin 5. The LED will remain on as long as I1's resistance remains unchanged. With air flowing across the lamp's exposed filament, the temperature of the filament goes down. When the temperature goes down, the filament's resistance also goes down, lowering the voltage at pin 4 of IC2, and the LED turns off.

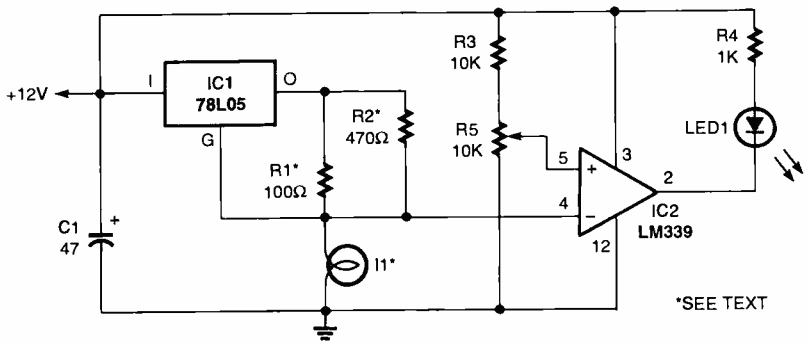


Fig. 3. Use this unconventional circuit to detect the presence of air flow. The flow of air across the modified incandescent lamp lights the LED.

PARTS LIST FOR AIR-FLOW DETECTOR CIRCUIT (FIG. 3)

C1—47-µF, 25-WVDC, electrolytic capacitor
I1—#47 incandescent lamp, or equivalent, see text
IC1—78L05 5-volt, 100-mA voltage regulator, integrated circuit (NTE977, SK3462, or equivalent)
IC2—LM339 quad voltage comparator, integrated circuit (NTE834, SK3569, or equivalent)
LED1—Light-emitting diode, any color
R1—100-ohm, ¼-watt, 5% resistor
R2—470-ohm, ¼-watt, 5% resistor
R3—10,000-ohm, ¼-watt, 5% resistor
R4—1000-ohm, ¼-watt, 5% resistor
R5—10,000-ohm potentiometer

If a #47 lamp can not be found, any of the following will work: #40, #44, #46, #1775, or other similar incandescent lamps. The #40 and #47 lamps operate at the same current and voltage, while the #44 and #46 require more current at the same voltage as the #47 lamp. The #1775 requires much less current and also operates at 6.3 volts. This is a fertile area for experimentation to find the most sensitive lamp that will give the greatest change in resistance for a given air flow.

The safe maximum current level for setting the lamp's exposed filament current level is about one-fourth to one-third its rated operating current. It's best to start out at a lower current value and work up slowly, because too much current will cause the filament to blow in short order. It's easy to use the 78L05 in a constant-current mode of operation. The resistor value required for a desired constant-current level can be found by using the following simple formula; "E" (regulator's output voltage), divided by "I" (the desired current), or R = E/I. In our circuit, a current of about 55 mA was required, so a 100-ohm resistor in parallel with a 470-ohm resistor did the trick. Start out with a current level about 20% lower than the desired current value and work up a few mA at a time. A 1000-ohm resistor in parallel with the other resistor(s) will increase the current level by 5 mA, a 500-ohm resistor will add 10-mA, *etc.*

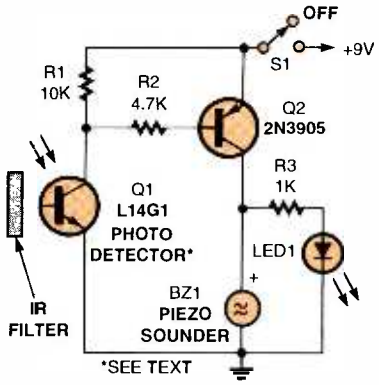


Fig. 4. This circuit detects infrared energy impinging upon the IR photodetector. The energy, in turn, sounds the buzzer and turns on the LED.

PARTS LIST FOR IR-DETECTOR CIRCUIT (FIG. 4)

BZ1—Piezo sounder
LED1—Light-emitting diode, any color
Q1—L14G1 phototransistor, (*Mouser* part 512-L14G1; Tel. 800-346-6873)
Q2—2N3905 PNP transistor (NTE159, SK3466, or equivalent)
R1—10,000-ohm, ¼-watt, 5% resistor
R2—4700-ohm, ¼-watt, 5% resistor
R3—1000-ohm, ¼-watt, 5% resistor
S1—SPST switch
IR filter material

IR-DETECTOR CIRCUIT

Our last entry this visit, see Fig. 4, is an infrared- (IR) detector circuit. This IR detector offers two different output indicators. A piezo sounder sends out an audible signal when the detector sniffs out an IR source. This can be a real help if you are searching for an IR source and are not in a position to look at the LED indicator.

The circuit's operation is very simple. Q1, a L14G1 photodetector, detects the IR input signal. Transistor Q1's collector current flows through the base-emitter junction of Q2, turning it and the two indicators, BZ1 and LED1, on at the same time. An IR filter is stationed in front of Q1 to help reduce the influence of non-IR light sources. Check out the local photo shop for the IR-filter material.

Well, that's about it for this visit; hope these circuits have detected your interests! Be sure to join us here next month, same time, same station. ■

DX LISTENING

(continued from page 50)

and ID, followed by classical music. At the same hour there are broadcasts in parallel on 9700 kHz.

CHINA—6950 kHz, China Radio International, Beijing, is heard here at 1230 UTC with an English language identification by a woman announcer.

CROATIA—6120 kHz, Croatian Radio has an English transmission at 0200 UTC, when it has been heard, following identification, with a report on the Balkans.

IRAQ—11785 kHz, Radio Iraq International. Look for this one evenings in Arabic, with English news at about 0400 UTC.

JORDAN—11690 kHz, Radio Jordan, broadcasting from Amman, has been logged here in English until an abrupt sign off at 1730 UTC.

LEBANON—6550 kHz, Voice of Lebanon is reported with Arabic-language programming and music from 0255 UTC.

LIBERIA—3400 and 5880 kHz, Star Radio signs on just before 0500 UTC with tone signal, Liberian anthem, and English-language identification.

MEXICO—4800 kHz, XERTA is logged between about 0800 UTC and 0930 UTC with ranchera-type rhythms and other Mexican music. While programming is in Spanish, this station has occasional English and French identifications. XERMX transmits at 9705 kHz in Spanish. Look for this one at around 1230 UTC with Mexican music, identifications, and promotional announcements.

NICARAGUA—5770 kHz, Radio Miskut's Spanish-language programming includes Mexican-style ranchera music after 1100 UTC.

NORWAY—7520 and 7545 kHz, Radio Denmark, relayed by Norwegian shortwave transmitters, can be heard here at 0300 UTC with Danish programs.

PERU—4991 kHz, Radio Ancash is noted with Spanish IDs and early morning music programming from around 0930 UTC.

SWEDEN—7115 kHz, Radio Sweden's "60 Degrees North" program is heard at 0330 UTC.

UZBEKISTAN—15295 kHz, Radio Tashkent has English at 1330 UTC, with identification and solicitation for sponsors to advertise on the station. ■

MULTIMEDIA WATCH

A Portable CD-ROM Drive, a New Mouse-Trak, and Software

MARC SPIWAK
ASSOCIATE TECHNICAL EDITOR
COMPUTER RESELLER NEWS

This month I've got a new portable CD-ROM drive from IBM that's a quick fix for all those notebook computers that have been sold without CD-ROM drives. It's also useful for notebooks that can't use their CD-ROM drive and floppy drive at the same time. IBM's *20× Max Portable CD-ROM Drive* (model 1969-011) has a fast PC-card interface to provide any notebook computer having a compatible slot with a CD-ROM drive, sound, and speakers.

The deluxe bundle is a complete multimedia upgrade in itself, and it comes with the CD-ROM drive and PC-card interface, NiCd battery pack and AC charger/power adapter, and stereo speakers with clips for attaching them to a notebook computer screen. The drive is 5.2 inches wide, 8.1 inches deep, and 1.3 inches high. It has a speaker jack on either side that the speakers can plug into directly, or they can attach to a notebook computer screen and connect to the drive using the included extension cables. The drive weighs 19 ounces.

The CD-ROM drive can double as a portable music CD player, so it has PLAY/PAUSE, STOP, SKIP, and VOLUME controls of its own, as well as a headphone jack. Drive status is indicated on an LCD readout. The drive also features a game port, microphone jack, and line input and output jacks for multimedia applications. Normal mode spins up to 20×, but there's also an economy mode that limits performance to 10× to extend battery life.

While the drive will rarely approach speeds of 20×, it is more than fast enough for any multimedia application or game that a notebook computer can run. I like the fact that the drive can double as a portable CD player so it can be used in a car or on the go. However, with its list price of $575, I'd be a bit too nervous to treat it like an $89 portable audio CD player.

This portable CD-ROM drive from IBM has a fast PC-card interface to provide any notebook computer having a compatible slot with a CD-ROM drive, sound, and speakers.

INDESTRUCTIBLE MOUSE-TRAK

Back in my April 1998 column, I talked about a space-saving pointing device for computers: ITAC Systems' *Personal Mouse-Trak*. That pointing device has a built-in wrist pad and trackball, along with three mouse buttons—and it sold for only $89. More recently I received an *Industrial Mouse-Trak*. Other than being a darker color, the industrial version looked identical to the personal version I had already seen. Though it looked identical, the industrial unit's price of $295 made me wonder why anyone would pay so much more for the same thing in a darker color. So I called ITAC Systems to find out.

Though certain parts of all Mouse-Traks, including a 5-ounce cast phenolic ball round to within ±0.005 inches with Rockwell H 85 hardness, along with the polished and hardened precision stainless steel shafts and ball bearings, are the same, there are other important differences. The *Industrial Mouse-Trak* is designed for harsh or controlled environments. It has a super-strong glass-filled Xenoy thermoplastic case, plus a conformal coating on the PC board to protect against caustic and conductive contamination.

The Industrial Mouse-Trak is designed for harsh or controlled environments with a glass-filled Xenoy thermoplastic case and conformal coating on the PC board.

I was dared by ITAC to drive over the industrial unit with my car. While the *Personal Mouse-Trak* is extremely durable, and unlikely to break in a personal environment, my car's weight would probably kill it. But the industrial unit has survived a demonstration drop of 500 feet from an airplane into a plowed field. While it is unlikely that a computer pointing device would fall out of an airplane by accident, they really can get bashed around in a factory environment. Buying one $295 device is cheaper over the long run than constantly having to replace $90 units as a cost of doing business.

The PC board's conformal coating is also interesting. While it obviously protects the board from contaminants and corrosion, it not so obviously keeps things in as well. I learned that controlled environments, such as clean-room silicon fabrication plants, must be protected from anything that out-gases contaminants, including PC boards, however insignificant the contamination might be to the rest of the world. Even the glass-filled Xenoy thermoplastic case produces less airborne contaminants than the ABS plastic case on the *Personal Mouse-Trak*. It is no surprise that the government and military have found many reasons to like the industrial version.

Like all Mouse-Traks, a single press of the middle button on the industrial unit can be programmed to execute a double click or a click and drag so you don't have to hold down the button—that can

WHERE TO GET IT

Activision
11601 Wilshire Blvd., Suite 1000
Los Angeles, CA 90025
310-473-9200
www.activision.com
CIRCLE 60 ON FREE INFORMATION CARD

Discovery Channel Multimedia
7700 Wisconsin Avenue
Bethesda, MD 20814
800-678-3343
www.planetexplorer.com
CIRCLE 61 ON FREE INFORMATION CARD

IBM Corporation
3039 Cornwallis Rd., Bldg. 203
Research Triangle Park, NC 27709
800-426-7236
www.pc.ibm.com
CIRCLE 62 ON FREE INFORMATION CARD

ITAC Systems Inc.
3113 Benton St.
Garland, TX 75042
800-533-4822
www.mouse-trak.com
CIRCLE 63 ON FREE INFORMATION CARD

LucasArts Entertainment Company
PO Box 10307
San Rafael, CA 94912
415-472-3400
www.lucasarts.com
CIRCLE 64 ON FREE INFORMATION CARD

MediaX Corporation
8522 National Boulevard, # 110
Culver City, CA 90232
310-815-8002
www.mediax.com
CIRCLE 65 ON FREE INFORMATION CARD

Merriam-Webster
47 Federal Street
Springfield, MA 01105
800-201-5029
www.m-w.com
CIRCLE 66 ON FREE INFORMATION CARD

Symantec Corporation
10201 Torre Avenue
Cupertino, CA 95014
800-441-7234
www.symantec.com
CIRCLE 67 ON FREE INFORMATION CARD

Syncronys Softcorp
3958 Ince Blvd.
Culver City, CA 90232
888-777-5600
www.syncronys.com
CIRCLE 68 ON FREE INFORMATION CARD

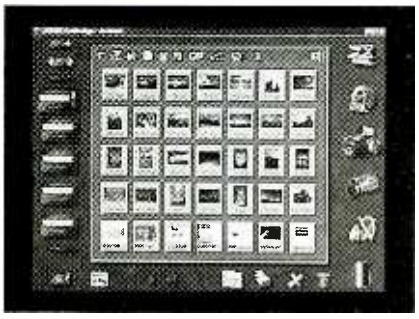
Vision Technology, LLC
643 Blair Island Rd, Ste. 210
Redwood City, CA 94064
415-299-9101
www.visiontechno.com
CIRCLE 69 ON FREE INFORMATION CARD

be difficult on a track-ball controller. It can be instantly switched between right and left-handed operation via a keyboard command. There is also a built-in speed control for the cursor. The unit works with the standard drivers supplied by an operating system, and it requires less functional space than a mouse and no special pad or surface.

NEW SOFTWARE

Archivist Pro from Vision Technology is a digital image archiving and presentation tool for Windows 95 or Windows NT. It lets you capture, manipulate, and archive photos, video, documents, and more—it recognizes over 250 file formats. It will also assemble and play multimedia slide shows. Users simply browse directories and choose the files they want to view, play, or archive. Archivist scans them and produces representative thumbnail images. Thumbnail size can be set to display more or less of them per screen. Users can create custom "drawers" for specific groups of images. The archiving function compresses the original files to save disk space. Entire thumbnail pages can be viewed at a glance, and any individual image can be viewed full size simply by double clicking on the thumbnail. This is a great product for sorting through the junk you download off the web. List price is $139.

If your C-drive is full but you need to install an office suite, just extend your C-drive with a simple slide and click. Syncronys Softcorp's *BigDisk* lets you do that and a lot more. If your C-drive is full and you want data to overflow to your new D-drive, *BigDisk* can do that too. You can even move entire application groups from one drive to another without causing problems running Windows. *BigDisk* has a safe undo feature to restore files back to their original locations should anything go wrong. Critical system files are identified and will not be moved. *BigDisk* has an estimated street price of $39.95.



Archivist Pro from Vision Technology scans files and produces representative thumbnail images. Thumbnail pages can be viewed at a glance, and any individual image can be viewed full size simply by double clicking on the thumbnail.

Peter Norton PC Guru from MediaX Corporation is an interactive CD-ROM that shows PC users of all levels how to make better use of the computer at home and at work. User support is provided by hot links to third-party web sites that provide trial software, upgrades, information, and so on. PC Guru is a great guide for the novice computer user, and it sells for under $30.

Anyone involved with maintaining a Lotus Notes database will appreciate Symantec's *Norton AntiVirus for Lotus Notes*. It provides comprehensive, automatic protection against old and new viruses with an interface that integrates smoothly with the Lotus Notes environment. Bloodhound technology guards against fast-spreading macro viruses, while LiveUpdate lets you schedule free downloads of the latest virus definitions. An AutoProtect mode provides unobtrusive background protection in real time. Norton for Notes costs $795 for a 25-user license.

New from Discovery Channel Multimedia comes *Evolution*, a strategy game written particularly for systems with MMX technology, though it will run fine on one without MMX. You begin as one of the earliest amphibians to crawl out onto land, competing with up to five opponents to evolve the first intelligent species. The world evolves during play, continents drift, sea levels rise and fall, climates change, and so on. Cataclysmic disasters will set you back, including asteroid impacts, ice ages,

(Continued on page 58)

ANTIQUE RADIO

John Rider's Remarkable *Chanalyst*

MARC ELLIS

HIGH-TECH SERVICING—1938 STYLE

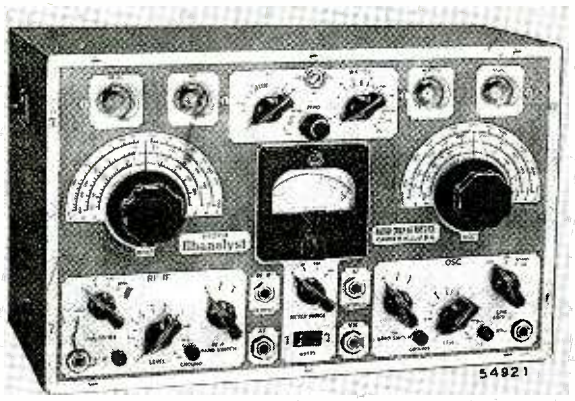
Towards the end of 1938, advertisements and articles covering a remarkable new test instrument began to appear in the radio service press. The device was developed and manufactured by John F. Rider, one of the industry's most noted writers and publishers. Aptly named the *Chanalyst*, it was hyped as a troubleshooting tool that would bring previously-unheard-of systematization and speed to the servicing process. The *Chanalyst* was born out of a need to save time in servicing receivers that were becoming ever more sophisticated and complex. However Rider's ad copy stressed that, because of the unique approach it employed, the *Chanalyst* would be just as useful with older sets. He went on to promise that the instrument would never become obsolete as long as radio broadcasting continued to utilize the standard AM band.

While the *Chanalyst* was certainly a new concept in test instruments, the servicing strategy it was designed to implement definitely was not. The instrument was simply a tool for signal tracing: a systematic troubleshooting technique that involved following the received signal through all of the stages of the inoperative receiver until it disappeared or became weak or distorted. With the defective stage pinpointed, the service technician could concentrate his efforts there—usually identifying the problem through making a few voltage measurements.

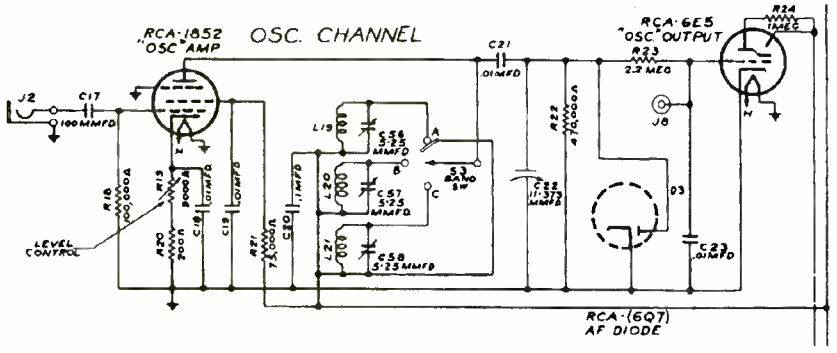
The Rider instrument was designed to put every possible tool for troubleshooting in the service technician's hands. For one thing, the *Chanalyst* did not merely *detect* the presence of a signal at the various stages of the receiver; it also provided a means of *measuring signal strength*. Thus the technician could determine the gain of each RF-, IF-, or AF-amplifier stage to see if the signal was being properly amplified at each point.

This versatile and flexible servicing

Rider's enthusiastic Chanalyst ad from the February 1939 issue of Radio Craft.



The Chanalyst's imposing front panel included magic eye indicators (top left and right) for each of the four test channels, a conventional meter for the "electronic voltmeter," and calibrated tuning controls for the RF-IF (left of meter) and oscillator (right of meter) channels.



Schematic of oscillator channel shows input jack, one stage of RF amplification, detector diode, and type 6E5 "magic eye" output level indicator.

tool also made it possible to monitor the signal at several points in the set at once: For instance, the serviceman might elect to look simultaneously at the oscillator plate, IF-amplifier plate, and audio-output amplifier grid. At the same time, the power draw of the radio under test would be under constant surveillance.

The difficulty could then be quickly and easily localized in a particular stage in the receiver or perhaps identified (due to abnormal power draw) as a power-supply short. Because all signal monitoring was done using vacuum tube voltmeter circuitry, the *Chanalyst's* test probes could be connected at any point in the receiver with minimal loading effect.

The multiple monitoring capability was especially useful in troubleshooting sets where the intermittent problem showed up only briefly and sporadically. No need to tease the radio into displaying the fault over and over again in order to try different diagnostic approaches. At a single glance, the technician could have an immediate bird's eye view of the signal's path throughout the set.

COLLECT IT AND USE IT!

Today's technician might smile at the service strategy embodied in John Rider's *Chanalyst.* It's hard to imagine a modern electronic device of any consequence that could be simultaneously monitored along all possible signal paths from input to output. Current techniques involve methodically advancing through the problem circuitry with scope probe or logic analyzer, uncovering more information in moments than the *Chanalyst's* four glowing tuning eyes could impart with any amount of knob twiddling.

But the *Chanalyst* (as well as later knockoffs of this instrument, such as the Meissner *Analyst* and the Hickock *Traceometer*) are engaging collectibles for those interested in old test instruments. Bristling with knobs, jacks, and indicators, they are fascinating to look at. And, though I've never personally used one, I'm convinced that one of these instruments would be a very useful addition to the test bench of any serious restorer of classic radios. They still turn up regularly at flea markets. In fact, I've been fortunate enough to acquire a *Chanalyst, Analyst,* and *Traceometer* for my personal collection. Sometime, I'd definitely like to restore one of them to reliable operating condition and try it out!

Let's make a quick tour through the *Chanalyst* and see exactly how it keeps tabs on the various circuits of the receiver under test. As its name implies, this instrument is organized into several independent test channels, each with a specific function. These are known as the RF-IF channel, the oscillator channel, the audio-frequency channel, and the wattage-indicator channel. Also considered one of the channels is the "electronic voltmeter," a VTVM with ranges of ±5, 25, 125, and 500 volts.

The output indicator for each of the channels (except for the electronic voltmeter, which has a standard meter) is a tuning eye. The greater the signal passing through the channel, the greater the closure of the eye. Let's begin our tour with the wattage-indicator channel, which watches the test receiver's power drain.

THE WATTAGE-INDICATOR CHANNEL

The power cord of the receiver being tested is plugged into a special socket built into the *Chanalyst.* From then on, all power drawn by the set is monitored by the wattage-indicator channel. After the receiver has been turned on and has warmed up, the operator turns a pointer knob with a scale labeled "watts" until the channel's tuning eye indicator just closes. The reading indicated by the pointer is the power, in watts, drawn by the set.

If the eye shadows overlap and can't be separated, power draw is excessive, probably because of an internal short. As a matter of fact, Rider suggests that, for a first-time turn-on, the electronic voltmeter (±500-volt scale) should be connected from the set's rectifier filament to ground to show power-supply output. If the output is zero or very low and the wattage channel shows abnormally large power draw, the set should be shut off immediately to avoid further damage.

THE OSCILLATOR CHANNEL

Take a look at the schematic of the oscillator channel (Fig. 1), and you'll

see that it's essentially a one-tube receiver (not counting the diode detector and magic-eye tuning indicator) covering three bands. These are 600 kHz to 1700 kHz, 1650 kHz to 4900 kHz, and 4800 kHz to 15000 kHz.

The main purpose of this channel is to monitor the oscillator of the receiver under test. In practice, a probe associated with the channel is connected to the oscillator circuitry, the channel's LEVEL control is set for maximum sensitivity, and the channel's calibrated tuning control is swept across the band until the tuning eye indicates signal pickup. Now, LEVEL is advanced until the eye almost closes and the tuning control is peaked for maximum indication on the eye.

The frequency of the oscillator may now be read from the tuning dial. (Factory specs for calibration accuracy are ±2%.) The setting to which the LEVEL control must be advanced to just close the eye is a measure of the oscillator's signal strength.

In addition to indicating frequency and strength of the oscillator signal, this channel can be used to observe if the oscillator is drifting, to check the frequency and strength of the service shop's RF test oscillator, and to set the pushbuttons of a radio equipped with them (part of a pushbutton's job is to select a specific oscillator frequency).

But the channel is not restricted for use with oscillators. It can monitor any relatively strong RF signal covered by its tuning range (having just one tube, it is relatively insensitive).

THE RF-IF CHANNEL

The RF-IF channel is also a three-band receiver (96 kHz to 260 kHz, 240 kHz to 630 kHz, 600 kHz to 1700 kHz), but it is much more sensitive than the oscillator channel because it has *three* stages of radio-frequency amplification. In fact, this channel is sensitive enough to pick up broadcast stations on its own with just a short antenna connected to its input jack. Like the oscillator channel, the RF-IF channel has a diode detector and a magic-eye signal-strength tuning indicator. A jack connected to the detector output is provided so that a set of headphones can be plugged in to hear the received signal if desired.

As its name implies, this channel is intended for tracing the received radio signal from the front end of the receiver through to the IF amplifier output. Because it is really a sensitive radio receiver in its own right, it can detect signals even where they are very weak, such as at the set's built-in antenna (or antenna terminal). Since the tuning range extends down to 96 kHz, the channel can pick up the signals after they are mixed down to the IF frequency and pass through the IF amplifier stage(s). It can handle not only the 455-kHz IF frequency that was standardized by the late 1930s, but also the lower frequencies common in earlier superheterodynes.

The RF-IF channel is used similarly to the oscillator channel; the signal to be checked is tuned in on a calibrated (±2%) dial and adjusted to a standard output level (making the tuning eye just close) by means of a level control. The settings of the level control can then be used to measure the gain of the signal as it passes through the various stages of the receiver. Stages not displaying the appropriate gain are pinpointed for troubleshooting.

But because this channel must respond to a very wide range of signal strengths (all the way from microvolt levels at the antenna circuit to the substantial output of the IF stages), the LEVEL control is supplemented by a four-position MULTIPLIER control calibrated in steps of ten. Through manipulating the LEVEL and MULTIPLIER controls, gain comparisons may be made involving signals over a range of 10,000 to 1.

Next time we'll discuss the audio frequency and electronic voltmeter channels and also see how the *Chanalyst* can be used for receiver alignment and other miscellaneous applications. We'll conclude by taking a quick look at the *Chanalyst's* major competition: the Meissner *Analyst* and the Hickock *Traceometer*.

UNFINISHED BUSINESS

Before we close for the month: Thanks to radio historian Alan Douglas for his identification of reader Camilo Castillo's "mystery" military set as pictured in the January, 1998 column. It turns out to be one of the Navy RAX-3 series. Besides the 7–27 MHz version in Camilo's hands, there are models covering 1.5–9 Hz and 200–1500 kHz. Alan believes the series dates from 1940–1941. ■

MULTIMEDIA WATCH

(continued from page 55)

comets, supernovas, volcanic eruptions, and more. This one costs $39.95.

Activision's *Shanghai: Dynasty* features four Shanghai games, plus the authentic Mah-Jongg multiplayer game. *Shanghai: Dynasty* combines tile-matching games with Internet, LAN, or modem multiplayer capability for powerful puzzle playing. *Classic Shanghai* dares players to match and eliminate tiles from a randomly arranged layout. *Pandamonium* lets up to five battle against the clock to remove tile pairs from the same layout. *Dynasty* challenges players to clear their own tile layout before their opponents do the same. *Shanghai for Kids* features fewer tiles and easier layouts. *Shanghai: Dynasty* will run you $39.95.

Merriam-Webster has introduced the new *Merriam-Webster's Medical Audio Dictionary* on CD-ROM. This is a must-have for anyone involved in medicine or filling out insurance forms. It's filled with explanations of today's health-care terms along with audio pronunciations for help in pronouncing the words correctly. Over 750 entries with color illustrations plus search options make look-ups among the over 57,000 entries fast and simple. This one sells for $39.95.

Jedi Knight: Dark Forces II from LucasArts is even better now with *Jedi Knight: Mysteries of the Sith*, a collection of new companion missions for Dark Forces. Mysteries of the Sith features 29 single and multiplayer levels and introduces a new playable character, Mara Jade, a former covert agent for the Galactic Empire. Players will battle more than 20 new creatures throughout Mysteries of the Sith, including a dreaded rancor, similar to the beast Luke Skywalker dramatically encountered in the Star Wars film *Return of the Jedi*. These missions will cost you $29.95. ■

NET WATCH

Translating Foreign Languages Online

KONSTANTINOS KARAGIANNIS

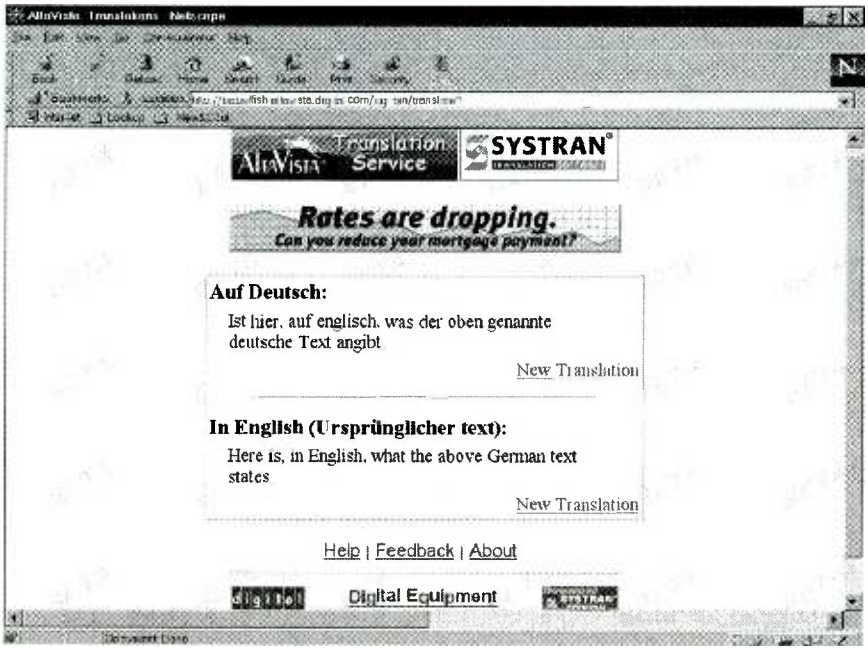
People so easily forget that the World Wide Web is really the *World Wide* Web. Name a country with computers, and they've got some kind of Web access. And that's a good thing, considering how many businesses rely on manufacturers and other businesses from other nations. Where would all our computer vendors be, for example, without their parts distributors in the Far East? E-mail and Web sites have become international tools for commerce.

Of course, as much as we in the States would like it to be so, English is not the universal language. In fact, there are more people alive who haven't even heard the English language spoken than there are those who can speak it. The world is, and probably always will be, multilingual, and until we learn how to use the other 90 percent of our brains, odds are we won't be able to handle more than a couple of languages at best (with years of study).

Computers and the Net have done a lot to close the international gap and help to bring us all a lot closer together. Now technology is attempting to make us all actually understand each other, too, through innovations in digital language translation.

The benefits of being able to electronically decipher other tongues might not be immediately obvious to many. A lot of you reading this are not necessarily working on million-dollar deals with someone that speaks only French. But some of you might have stumbled across a potentially useful Web site that is written in another language. Or, perhaps, you have someone you need to contact in another land, and would like to be able to write him or her an e-mail in a language that this person can understand.

This month we're exploring ways to translate several languages online, sometimes for free. While you could buy software to do such a task, and we do cover such an option briefly later on, isn't it so much more fun to just point and click your way in cyberspace for free?



Here's a simple example of how AltaVista's powerful Translation Service works. Translated text is shown at the top of the screen with the original passage appearing at the bottom.

ALTAVISTA TRANSLATIONS

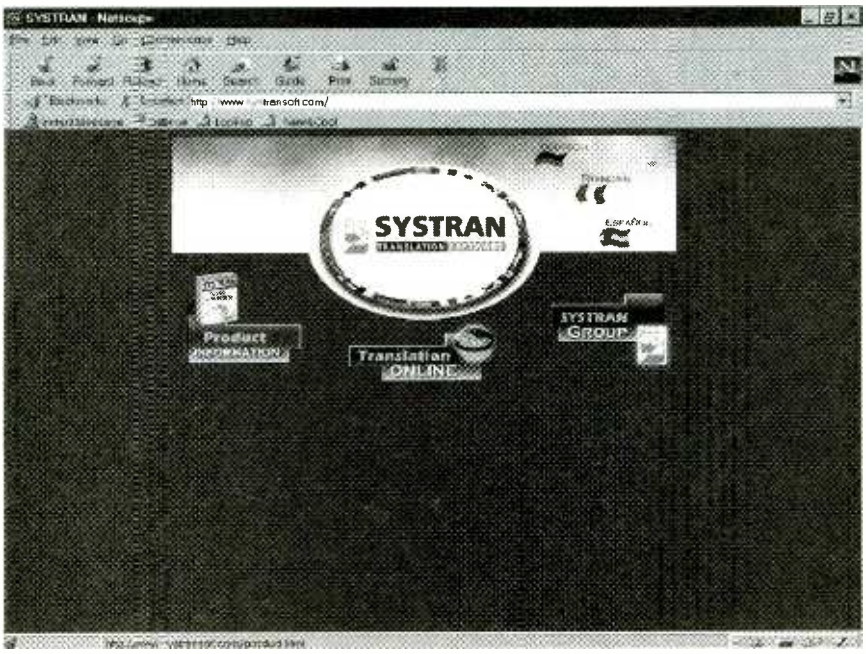
This first site is quite simply one of the most powerful and impressive I've ever seen. It's free, you don't need to register to use it, yet you'll swear you have access to some kind of high-priced corporate service. Powered by a server running SYSTRAN Translation Software (more on this in a moment), AltaVista Translations enables you to quickly shatter the online language barrier.

While the initial screen might not be visually stunning, what the site can do certainly is dazzling. A query box is presented wherein you can either type or paste a selection of text, or enter a URL (uniform resource locator, or simply a Web address).

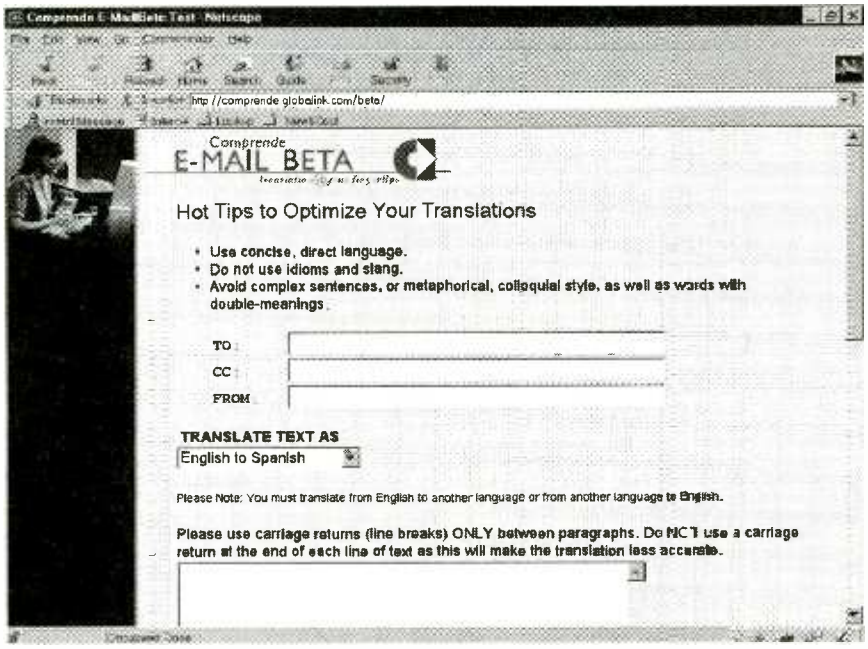
If you place text in the box, you are limited to 1K of data (about 160 words). You would then select what you want done to the text from a pull-down menu. The choices are translating from English to either French, German, Italian, Portuguese, or Spanish, or translating from any one of those five languages into English. Then just press the translation button and wait a few seconds.

A screen will appear with your translation at the top and the original text at the bottom. This is important, because if you pasted too much text, the service will cut off after approximately 1K. If the original text window at the bottom shows all your entered text, then the translation at the top is complete. If not, go back and translate the text in 1K sections.

The URL entry option is powerful as well. If you enter one of these into the original query box, the service will load the page, translate up to 5K of it, and display it, links intact. This is neat not only because it translates five times as



At the heart of the AltaVista Translations server is the powerful SYSTRAN program. You can buy a copy of the software from the company's Web site if you feel like doing your translating offline.



Comprende, still in a free beta test at the time of this writing, offers a powerful way to not only translate e-mail messages and Web sites, but to work with newsgroups and chat applications on-the-fly.

much data, but also because you end up with a page you can use just like any other. If you choose a link on the translated site, you will be presented with another AltaVista Translation query box with that link's URL in it. Click the translation box, and you'll be at the translated linked page in seconds.

You might be wondering how the quality of the translations is, right? Surprisingly good, actually. While some idioms and complex sentences get jumbled, and a few words remained untranslated, you really do get more than just the gist of what is being said. If the sentences are simple ones to begin with, translation is near perfect. For example, if you want to write a letter in German, and keep the constructions to, say, simple subject, verb, predicate, you may be able to fool even a language professor into thinking you've picked up Deutsche.

Now for my complaint... I didn't mind that there were text-size restrictions. Let's face it, in a matter of days the site would be bombarded and unusable if there weren't. I did mind that there wasn't a logical way to continue translating a document after the limit. A link appears saying "Translation Ends Here," but when you click it, you don't get a query box that allows you to resume the translation. You get a blank box, which means you have to go back and find where the translation ended to pick up where the service left off.

Still, for a free site, AltaVista's service is pretty close to perfect. If you don't want the online hassle of pasting small clumps of text, you could order (and download after you pay) a personal version of the SYSTRAN software from the site of the company of the same name (see the SYSTRAN entry in the "Hot Spots" box). The program lets you paste in 5K of text at a time, instead of only translating that much off the Web. For $29 you get a one-way version of one language (*i.e.*, English to French). Paying $49 gets you a two-way program (*i.e.*, English to French, French to English). Your choices are limited to the five languages mentioned earlier, but if you want to spend hundreds more, there's a pro version that includes others, including Asian ones.

GLOBALINK COMPRENDE

This is where "free" becomes a relative term. At the time of this writing, Globalink's excellent and diverse Comprende service is in a free beta test. However, by the time you read these words that might not be the case.

The site's similar to the AltaVista one in that it lets you translate by pasting text, and also accommodates Web sites by dynamically translating the HTML (hypertext markup language) and displaying it on your browser as if it was originally created in your chosen language. However, Comprende takes this one step further, working with any kind of Internet text. This means you can dynamically read and post to Usenet newsgroups from any country, and even participate in multilingual IRC (internet relay chats)—very impressive, indeed.

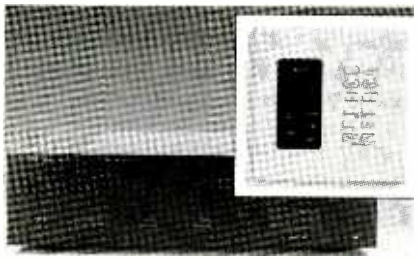
Because chances are the site will no longer be free by the time you read this, you'll have to decide if on-the-fly translation within any Net application is worth it. For $19.95 a month you get a

(Continued on page 64)

New Products

MULTI-ROOM SYSTEM

Manufactured by Rotel, the *RMZ-955 Multi-Room Sound Distribution System* distributes sound from four source components to as many as four separate zones in a home. Each zone features fully independent operation. System components include a controller/amplifier, hand-held remote, in-wall keypad, and IR sensor/display. Paging facilities are available for internal use throughout the house. The system combines sound quality, flexibility, and an easy-to-use interface.



Using the hand-held controller or the conveniently-mounted keypad, you can select a CD or DVD, a satellite broadcast, or start or rewind a tape. Built-in amplification handles most needs while additional preamp outputs provide easy connections to separate power amplifiers, if needed for your system's demands. Status indicators on the front panel show which zones are active and which zones are actually transmitting control requests through the system.

The RMZ-955 controller/amplifier and remote control retails for $2500. Keypads and sensors cost $450 a pair. For more information, contact Rotel of America, 54 Concord Street, N. Reading, MA 01864-2699; Tel. 978-664-3820; Fax: 978-664-4109.

CIRCLE 80 ON FREE INFORMATION CARD

PORTABLE 2-METER AMPLIFIERS

Now you can have the power of a 35-watt base station with your 2-meter handheld radio. Just plug your handheld radio into the *PowerPort RF-35*, grab the carrying strap, and take it with you wherever you go. The RF-35 is fully self-contained with its own portable power supply that provides 35 watts anywhere; you no longer need separate set-ups for your car, home, or out in the field.

The rechargeable *PowerPort RF-35*, distributed by Cutting Edge Enterprises, amplifies your signal to 35 watts. With 9 amp-hours of on-board 12 VDC power, you can maintain communications all day, anywhere without a break to recharge. With two and half hours of solid transmit time and unlimited standby, the unit will outlast your battery.

The unit is fully charged, comes with RG-174/U mini-cable with BNC connector for your Handy-Talkie (HT), and a mini "J" antenna on 10 inches of cable. The RF-35's carrying case also has removable side pockets to hold your HT and accessories. For something even more lightweight (3 pounds and 2.3 amp-hours of DC power), the RF-35Jr. will provide three-quarters of an hour of solid talk and unlimited standby.

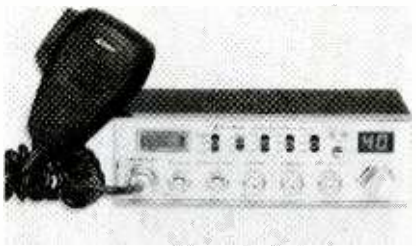
The *PowerPort RF-35* costs $179.95 and the *PowerPort RF-35Jr.* costs $159.95. For more information, contact Cutting Edge Enterprises, 1803 Mission St., Suite 546, Santa Cruz, CA 95060; Tel. 800-206-0115 or 408-429-5384; Fax: 408-426-0115.

CIRCLE 81 ON FREE INFORMATION CARD

CB RADIO

Designed with the serious CB user in mind, the *148 GTL ST* uses SoundTracker, Cobra's noise-reduction technology that improves the transmission and reception of CB signals. With the static that usually accompanies both incoming and outgoing signals virtually eliminated, SoundTracker produces a cleaner, crisper-sounding CB with stronger outgoing signals.

Measuring $7^3/_4$- by $2^1/_4$- by $9^1/_4$-inches, this CB radio is loaded with user-requested features, such as a front microphone connector, a heavy-duty microphone, and tactile controls. The fins and flats on the dials enable users to feel where the dial is in its rotation without looking. Ergonomically designed to fit the palm of the hand, the 4-pin dynamic microphone has rounded, sculpted surfaces that make it easy to hold.



The *148 GTL ST* has a 12-watt single side-band-RF Power Output that increases range capabilities and boosts 40 upper and lower channels, bringing the channel total to 120. Other features include an advanced logarithmic speech processor, switchable noise blanker and ANL, brightness dial control, and a full-function illuminated meter.

The *148 GTL ST* CB Radio is priced at $279.95. For more information, contact Cobra Electronics Corporation, 6500 W. Cortland St., Chicago, IL 60707; Tel. 773-889-8870; Fax: 773-794-1930.

CIRCLE 82 ON FREE INFORMATION CARD

SIGNAL LINE PROTECTION

Intended for high-end home theater and satellite systems, the *MAX 1500* protects against surges and spikes, including lightning. The unit also provides AC protection and line conditioning for DBS systems. There are three sets of coax protection, one for satellite signal, another for cable TV and/or rooftop antenna, and the third to run a signal downline. The unit also includes protection for one phone, which can be used for pay-per-view.

Power line conditioning in the *MAX 1500* eliminates up to 99.9 percent of all EMI/RFI or "noise" over the full bandwidth range of 100 kHz to 1 MHz to provide exceptional picture and sound. In addition, the unit offers sequential startup, automatic reset and shutoff, and under/over voltage protection. It also features diagnostic lights, voltage indicator lights, and a remote

control to power an entire system up or down remotely.

Ten AC outlets are included, four of which are always on for programmable components such as TV or VCR. Four outlets are controlled by a master switch and voltage trigger, and two have delayed responses. The device has a UL 1449 surge protector rating of 330 volts, catastrophic fusing that protects the circuitry, and thermal fusing which prevents fire.

The *MAX 1500* retails for $499. For more information, contact Panamax, 150 Mitchell Blvd., San Rafael, CA 94093; Tel. 800-472-5555 or 415-499-3900; Fax: 415-472-5540; Web: *www.panamax.com.*

CIRCLE 83 ON FREE INFORMATION CARD

PC SCREEN MAGNIFICATION SYSTEM

Bausch & Lomb recently introduced the first optical lens personal computer magnification system. The *PC Magni-Viewer* magnifies on-screen information 175%, offers multiple adjustments for customized monitor viewing, and automatically positions PC users in an ergonomically correct work posture.

The product is ideal for professionals who need to be able to increase the amount of information displayed on screen by reducing the font size. The completely adjustable, two-piece magnification system features a 19.5- by 15-inch 360° rotating base that sits underneath any 13-, 15-, or 17-inch PC monitor, an adjustable swivel-arm that extends over the top of the monitor, and an adjustable precision-ground and polished 6- by 8-inch acrylic optical lens that weighs only 25 ounces.

The *PC Magni-Viewer* is easy to use and easier still to install. Users simply place the rotating base beneath the monitor and attach the magnifier arm into the built-in socket. The vertically and horizontally adjustable lightweight lens, which is attached to the magnifier arm, delivers corner-to-corner image magnification and in-focus sharpness.

Both the height of the arm and its closeness to the monitor can be adjusted depending on the size of the monitor and the needs of the user. Like the base, the arm can horizontally rotate 360°, facilitating storage out of the way when not needed.

The *PC Magni-Viewer* is priced at $250, plus $10 for shipping. For more information, contact Bausch & Lomb, 1400 N. Goodman St., Rochester, NY 14692-0450; Tel. 800-553-5340 or 716-338-6660; Fax: 716-338-8798; Web: *www.bauschvision.com.*

CIRCLE 84 ON FREE INFORMATION CARD

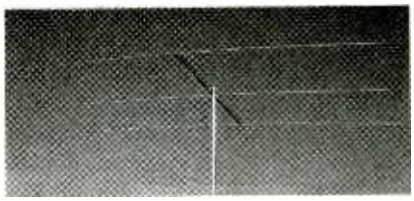
DIRECTIONAL ANTENNA

A directional antenna is essential for long-distance VHF communications. By focusing transmitter power onto the horizon in a single direction, the *MFJ-1762* three-element 6-meter Yagi quadruples Effective Radiated Power (ERP) over a half-wave dipole. The same benefit applies when receiving—sensitivity towards the front of the antenna is improved greatly over a dipole, while unwanted noise and interference from other directions are rejected.

The antenna's main lobe (area of maximum sensitivity) is 70 to 80 degrees wide. This means you can converse with several stations in one general direction without having to constantly reposition your rotator for maximum signal.

Two *MFJ-1762s* can be stacked to double the transmitter ERP and the received signal over a single antenna. It also doubles the received signal. Stacked antennas have greater capture area, which can improve reception even more.

Designed for installation with readily available TV masts, the antenna weighs two pounds and has a boom length of six feet. A current balun decouples the 50-ohm feedline from the antenna. Because of its light weight, compact size, and easy-to-remove elements, the *MFJ-1762* is suitable for portable or mobile operation. It can be mounted horizontally or vertically. MFJ's "NoTune Hairpin" impedance-matching system is used for the driven element, and no further tuning should be needed for coverage in the 50-MHz SSB band.



The *MFJ-1762* three-element 6-meter Yagi retails for $69.95. For more information, contact MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville, MS 39759; Tel. 800-647-1800 or 601-323-5869; Fax: 601-323-6551; Web: *www.mfjenterprises.com.*

CIRCLE 85 ON FREE INFORMATION CARD

DATA/FAX MODEM

According to NewCom, Inc., their *56K Internal Data/Fax Modem* is the fastest analog modem available for conventional telephone lines. The modem uses USR X2 technology, which is the most widely supported 56K-modem protocol. Since most internet providers offering 56K service use the X2 protocol, NewCom's modem is a reliable vehicle for Internet downloading.

The 56K modem features the Cirrus Logic CL-MD56XX chipset and allows users to download at a rate of up to 56Kbps, upload at 33.6 Kbps, and fax/send/receive at 14.4 Kbps. The chipset incorporates a RISC processor, along with a high-bandwidth DSP. The chipset's high-performance architecture supports advanced features such as V.80 for video-conferencing, full-duplex speakerphone, the Radish ChoiceView protocol, and telephone answering machine capabilities.

NewCom's complete 56K modem line includes the internal data/fax modem, the internal data/fax voice modem, an external model, and a speakerphone version. All modems are ready for plug-and-play installation, and they come complete with modular phone cable, user manual, and communications software.

The *NewCom 56K Internal Data/Fax Modem* has a suggested retail price of

$134.98. For more information, contact NewCom, Inc., 31166 Via Colinas, Westlake Village, CA 91362-4500; Tel. 800-5NEWCOM or 818-597-3200; Fax: 818-597-3210; Web: *www.newcominc.com.*

CIRCLE 86 ON FREE INFORMATION CARD

WIRELESS KEYBOARD

Suitable for IBM-compatible PCs utilizing Windows 3.x or Windows 95, the SurfMate is a 79-key plug-and -play wireless keyboard that requires no software installation. The user simply plugs Surfmates' receiver unit into the computer's keyboard port, and it's ready. The keyboard is compatible with all Internet applications, including Web browsers and e-mail, and it can be used with any software, such as presentation programs, games, word processing, and accounting.

The *SurfMate Wireless Keyboard* gives users the freedom to be almost anywhere in a room and still maintain complete control of the computer. It transmits through infrared LED at distances up to 45 feet and, depending on the distance to the PC, at horizontal angles up to ±60 degrees and vertical angles up to ±50 degrees. An optional integrated pointing device replaces the mouse.

SurfMate comes equipped with four AA alkaline batteries and weighs only 21 ounces, including batteries. The *SurfMate Wireless Keyboard* has a suggested retail price of $129.99. (It can be purchased directly from the Web site listed below for $99.99, including shipping and handling.) For more information, contact US Electronics, 585 North Bicycle Path, Suite 52, Port Jefferson Station, NY 11776; Tel. 800-873-2552; Fax: 516-331-2552; Web: *www.surfmate.com;* e-mail: *info@surfmate.com.*

CIRCLE 87 ON FREE INFORMATION CARD

THERMOCOUPLE MODULE

The Type K Thermocouple Module, Model *TMA-K*, enables the user to turn any digital multimeter into a thermometer. The module expands the capability of any digital multimeter (DMM) with a DC millivolt resolution and makes direct measurement of temperature possible.

The *TMA-K* plugs into a DMM and converts the output of the thermocouple's signal to 1 millivolt DC per degree that is displayed on the DMM. The user can select Centigrade or Fahrenheit for the display by using the slide switch on the front of the module. The temperature measurement range can be expanded up to 1830º F (1000ºC), using any properly rated K-type thermocouple.

The module comes complete with thermocouple, TPK-56, for temperature measurements from −40ºF to +400ºF (−40ºC to 204ºC). A 9-volt battery is included. The *TMA-K* has a suggested retail price of $59.85. For more information, contact Amprobe Instrument, 630 Merrick Road, P.O. Box 329, Lynbrook, NY 11563; Tel. 516-593-5600; Fax: 516-539-5682.

CIRCLE 88 ON FREE INFORMATION CARD ■

ELECTRONICS LIBRARY

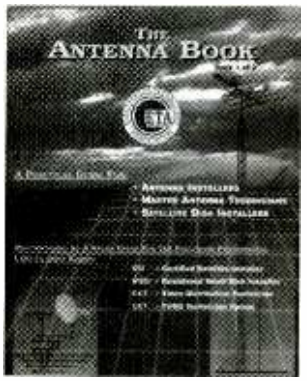
(continued from page 33)

THE ANTENNA BOOK, BOOK 1 of 2

from the Electronics Technicians Association

Designed as a practical guide for antenna and satellite dish installers and master antenna technicians, this book is written by experts in the field. The book covers in depth theory, installation, and troubleshooting information on rooftop TV antennas; satellite systems, both large and small; and master antenna distribution systems—SMATV.

In addition to being an excellent



text for those who want to understand wired and wireless distribution of RF signals to private homes and multiple dwelling units, this guide is recommended as study material for the Certified Electronics Technicians (CET) exams, or for the Certified Satellite Installer (CSI) and Registered Small Dish Installer (RSDI) options. Each chapter ends with a quiz and the book ends with a practice quiz to give readers experience with the types of exam questions.

The Antenna Book costs $24.95 retail ($20 for ETA-SDA members) and is published by Electronics Technicians Association, Int'l. and the Satellite Dealers Association, Inc., 602 N. Jackson St., Greencastle, IN 46135; Tel. 800-288-3824; Fax: 765-653-8262; E-mail: eta@indy. tdsnet.com.

CIRCLE 92 ON FREE INFORMATION CARD ■

E.Z. GENERATOR

(continued from page 40)

the supply terminal of IC1 and IC2 and ±12 volts at those of IC3–IC5. If the voltages are incorrect or don't appear at all, turn off the power to the circuit immediately and correct the problem. If all is well, move on to the next phase, which requires the aid of a scope.

Set the scope for DC coupling, and using a standard ×10 scope probe, attach the ground clip to the +1.9-volt reference bus on the signal-generating board. Set all trimmer potentiometers on the board to mid-rotation, S1 to 10 kHz, S2 to triangle-wave output, R20 to minimum amplitude, and R8/R14 to ×0.1 (minimum multiplier factor).

Apply power to the circuit, and check the output waveform of the circuit. The scope should display a triangle wave of about ±1.0 volt at about 1kHz. Due to input offset current tolerances, the triangle slopes may not be exactly straight, but slightly curved. If so, try swapping IC3 with IC4 and/or IC5 for best results. The distortion disappears at ×0.2 and above.

When satisfied, advance R8/R14 to ×0.2 for a 2-kHz display. Set the scope's sweep speed to display several cycles and its vertical-position control so that zero volts lies exactly on the center graticule line. Adjust R6 so that the maximum voltage excursions are exactly equal on each side of the zero-volt line. That adjusts the triangle-wave voltage symmetry. Next, set the scope's sweep speed to display only one cycle of the 2-kHz triangle wave. Adjust R12 so that the triangle-wave's positive half cycle is exactly equal in length to its negative half cycle on the horizontal time axis. That adjusts the triangle-wave's time symmetry. The lowest sinewave distortion occurs when the triangle wave is perfectly symmetrical. After that, set S2 to the sinewave position and the scope should display a 2-kHz sinewave at an amplitude of about ±1.0 volts. Carefully adjust R18 to achieve voltage symmetry of the sinewave, as was done with the triangle wave. Advance R8 and R14 to ×1.0 for a 10-kHz display, and set S2 for a square-wave position. Adjust R10 for a display of exactly 10.0 kHz. That calibrates the frequency scaling of the instrument.

Reset S2 to the sinewave position and set S1 to 1.0 MHz. Adjust C15 for a sinewave maximum excursion of ±1.0 volt. That adjustment corrects the high-frequency, sinewave-voltage amplitude response of the sine converter.

Finally, remove the ×10 scope probe and ground lead from the generator and the oscilloscope. Connect a standard BNC cable assembly, 3 feet or less in length, from J1 of the generator to the scope's vertical input. Set the generator controls for a 10-kHz triangle-wave output. Advance R20 for a display of about ±1-volt maximum excursion.

Set the scope's sweep speed to display several cycles of the triangle wave. Then carefully adjust R23 for exact voltage symmetry of the waveform, as was done previously. This adjustment correctly sets the level shift of IC5 for an output that is symmetrical about ground rather than the +1.9-volt reference used throughout the rest of the circuit. That completes the set-up for the E.Z. Signal Generator.

The generator is now ready to be pressed into service—you'll find it to be extremely versatile and easy to use. Its wide frequency range coupled with short-circuit protection and large-amplitude range allows just about any procedure to be performed.

If you run into any problems with the project, or have any questions or comments concerning it, feel free to contact the author c/o **Popular Electronics** for an immediate response. ■

NETWATCH

(continued from page 60)

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And that about wraps it up for now. Until next time, *parcourir heureux*, or *glückliches durchstöbern.* Sorry, couldn't resist. If you feel like getting in touch, in any of several languages thanks to this month's sites, feel free to e-mail me at netwatch@comports.com. Send English snail-mail to *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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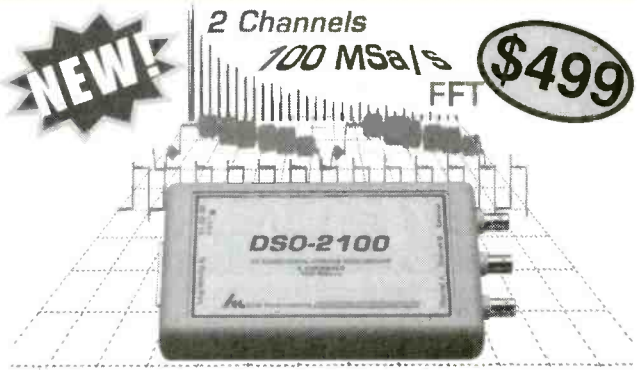

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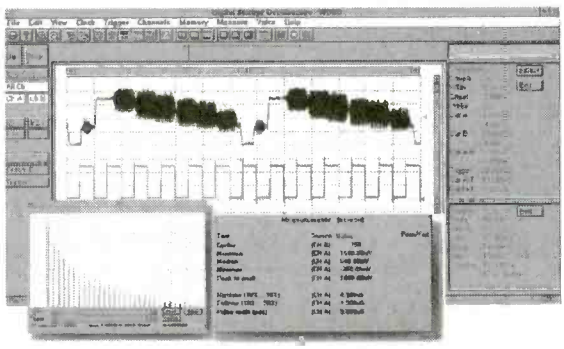

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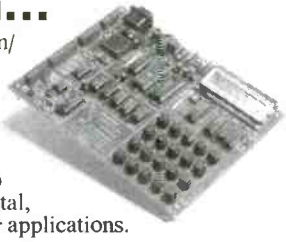

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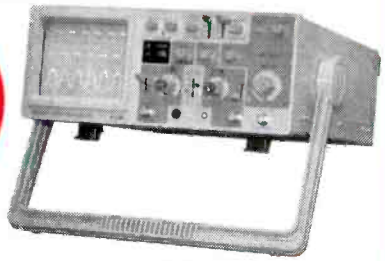

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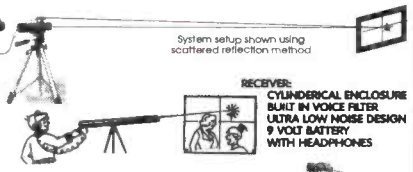

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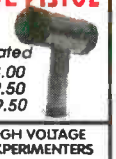

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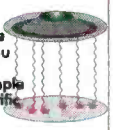

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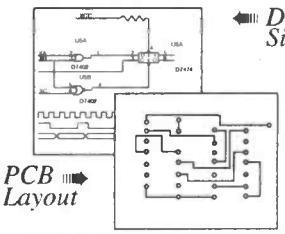

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It is not the intent of Greenleaf Electronics to defraud any pay television operator and we will not assist any company or individual in doing the same.

NOW MAKE AN EXTRA $600 PART TIME WEEKENDS -- UP TO $2,000 A WEEK FULL TIME IN *Explosive* SATELLITE DISH TV/ELECTRONICS FIELD!

Hottest Career Opportunity Since Invention of the VCR!

See How Fast The Money Rolls In!

Part time: *Here's what you can earn over a typical weekend:*

Install 2 Satellite dish systems at $200	= $400
Repair 4 TV's at $50 each	= $200
Total Weekend Income	**= $600**

Full time: *Working just five days a week you could easily earn:*

Install 5 Satellite dish systems at $200	= $1,000
Repair 10 TV's, average $50 each	= $500
Clean and adjust 10 CD players, average $35 each	= $350
Service 2 Home entertainment centers at $75	= $150
Total Weekly Income	**= $2,000**

In addition you can make big extra profits on other supplies you furnish!

Get in *THE FAST LANE* on the NEW "INFORMATION SUPERHIGHWAY" Everyone's Talking About!

It's exciting! It's gigantic! The technology of tomorrow is here today! You've been reading and hearing about the amazing Information Superhighway. It's so new that few technicians are equipped to service this fast emerging field! Foley-Belsaw gives you Satellite dish technology (including new mini-dish) along with the electronic expertise you need to make big money servicing TVs and other electronic equipment.

Be your own boss! It's quick and easy to become an expert at home in your spare time. Earn really BIG money adjusting, installing and repairing · ***Satellite dish systems · TVs · Amplifiers · CD players · AM/FM tuners · Home entertainment centers.*** Every home, every business, every office in your area desperately needs your expertise!

Your timing just couldn't be better! Never before and probably never again will you have a ground-floor opportunity like this to get into a booming business of your own, make really big money starting right away, be your own boss and enjoy financial freedom and security. The fact you're reading this message shows you're smart enough to realize this!

Satellite dish/TV/Electronics is easy to learn in your spare time at home. This modern, practical hands-on course combines simple step-by-step lessons with easy-to-follow video cassette guidance. No special experience or electronics background is necessary. Just average mechanical aptitude and the ability to follow simple A-B-C repair procedures that are clearly outlined for you.

And when you complete the course you will receive Foley-Belsaw's official diploma attesting to your expertise.

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MAIL TODAY FOR FREE INFORMATION PACKAGE

Foley-Belsaw Institute
6301 Equitable Road
Kansas City, MO 64120-1395

FOLEY BELSAW *Since 1926*

- ☐ **YES!** Without obligation send free information kit so I can learn how to become a professional **Satellite Dish/TV/Electronics Specialist,** in order to earn high extra income **Dept.** 31582
- ☐ **VCR Repair**-Unlimited profits in this growing field. **Dept.** 62811
- ☐ Interested in an exciting, money making career in **Computer Repair, Maintenance and Upgrade? Dept.** 64713
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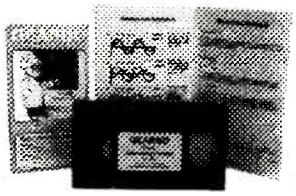

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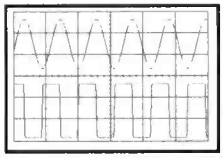
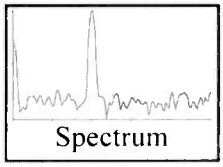
ATC O-Scope uses printer port to turn PC-AT into Digital Storage Oscilloscope, Spectrum Analyzer, Freq. Counter, Logger, DVM. DC-500KHz





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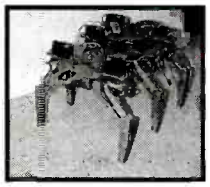

• Sensors/Emitters •

GP1UYRGP32/40 $6.89/ $3.49
32khz/40khz Infrared Digital Sensors
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MIR27ERGP $1.39
Corresponding IR emitters

• Communications Boards •

*First-time buyers of Mekatronix™ brand products need the Com-Kit $19.95 OR the Com-Pack $27.95.
The card plugs into the back of your PC's serial port/cable.
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CCAMPALGP -Wireless color mini-camera spy $298.95
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AANCGP -6 AA Rechargeable NiCad batteries $14.55
IRREMGP - Remote control module for Talrik Jr. $22.95

• Servos •

MS455RGP -42 oz-in dual ball bearing servo $13.95
MS455HGP -Servo modified/continuous rotation $19.95

• Software •

HSDL11GP - MC68HC11 115.2 Kbps downloader $8.95/ W95
ICC11GP -v4.5 HC11 C-Compiler $71.50 Dos /$125.50 Win
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Fantastic DMM Offer!!!

Don't let the price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/RANGE selector rotary switch.

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$19.00 any qty

General — **Rubber Boot Included**

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges: Operating: 0°C to 40°C (32°F to 104°F) Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery(NEDA1604)
Low Battery Indication: BAT on Left of LCD Display
Dimensions: 188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)

Range:	*Resolution:*	*Accuracy:*
200mV	100µV	
2000mV	1mV	±(1%rdg+2dgts)
20V	10mV	
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

Range:	*Resolution:*	*Accuracy:*
200µA	100nA	
2000µA	1µA	±(1.2%rdg+2dgts)
20mA	10µA	
200mA	100µA	±(1.2%rdg+2dgts)
10A	10mA	

Overload Protection: mA Input. 2A/250V fuse.

Resistance (Ω)

Range:	*Resolution:*	*Accuracy:*
200Ω	100mΩ	
2000Ω	1Ω	
20KΩ	10Ω	±(1.2%rdg+2dgts)
200KΩ	100Ω	
2000KΩ	1KΩ	
20MΩ	10KΩ	±(2%rdg+10dgts)

Maximum Open Circuit Voltage: 2.8V

Diode Test
Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.

ohFE Test
Measures transistor hFE.
Frequency Range: 45Hz-450Hz
Maximum Allowable Input: 750V rms
Response: Average Responding. Calibrated in rms of a Sine Wave.

AC Voltage (ACV)

Range:	*Resolution:*	*Accuracy:*
200V	100mV	±(1.2%rdg+10dgts)
750V	1V	

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	$19.00

Positive Photofabrication Kit
Make your own PCB's

Kit includes the basic items needed to fabricate pre-sensitized printed circuit boards (does not include artwork). Also included is a basic process guide to assist the user in the basics of exposing, developing and etching a PCB. All items fit conveniently in the plastic development tray, and a tight fitting lid is included for handy storage. Additional recommended supplies for fabricating PCB's are: exposure bulb, etchant tank, eye protection, art-work, paper towels.

Kit Includes

- 1 each 3"x5" pre-sensitized single sided PCB
- 1 each 4"x6" pre-sensitized single sided PCB
- 1 each 6"x6" pre-sensitized single sided PCB
- 1 each 500ml developer liquid
- 1 each 500ml ferric chloride etching liquid
- 2 each foam brushes
- 1 each plastic development tray
- 1 each rubber gloves
- 1 each instruction sheet

new!

CAT NO	DESCRIPTION	PRICE
416-K	Photofabrication Kit	**$27.95**

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12"	12.78	10.65	8.52

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114	114mm x 165mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80
GS1212	305mm x 305mm/12" x 12"	18.88	15.73	12.59

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114	114mm x 165mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30
GD1212	305mm x 305mm/12" x 12"	22.09	18.35	14.68

Exposure System

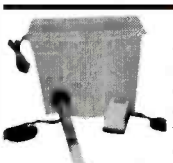
Just place your presensitized board and artwork centered under the exposure fixture. Place the convenient acrylic sheet over the board and artwork to hold everything in place. Turn on light. Voila! Exposure takes about 5 minutes. Kit includes one fluorescent tube, stand and acrylic weight.

new!

Features

- Exposes boards in about 5 minutes!
- Convenient acrylic sheet to hold board in place during exposure (12.5" x 8.5")
- Fluorescent light fixture with plastic cover designed to aid in proper light refractions for even exposure

CAT NO	DESCRIPTION	PRICE
416-X	Fluorescent Exposure System	**$31.95**
416-B	Extra Replacement Fluorescent Tube	**16.95**



Etching Tank This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	$37.95

Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
POSDEV	Positive Developer	$ .95	$ .80	$ .50

Etching Chemicals/Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	PRICE EACH 1	5
ER-3	Makes 1 pint	$3.50	$2.75

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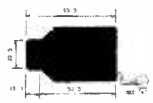
Color Weather Proof Bullet Camera

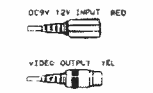
1/3" CCD with removeable rotation capable mounting bracket

new!

Specifications

Image Sensor:	Interline transfer CCD 1/3" format
Effective Pixel:	512(H)x492(V) pixels/NTSC 512(H)x582(V) pixels/PAL
Scanning System:	2 : 1 interlaced
Sync System:	Internal sync
Sync Pulse:	15.734KHz +1%(H)/15.625KHz +1%(H) 59.94Hz +1%(V)/ 50Hz +1%(V) Sub-Carrier 3.57 MHz +30ppm
Resolution:	400 TV lines (H)
S/N Ratio:	More than 46dB (typ)
Gamma Characteristics:	0.45
Min. Illumination:	1 LUX (F1.2 10 IRE)
Video Out:	Composite video signal : 1.0Vp-p
White Balance:	Auto white balance
Electronic Shutter:	1/60 - 1/100,000 SEC(N) 1/50 - 1/100,000 SEC (P)
Power Supply:	DC 12V + 10%
Power Consumption:	240mA (typ)
Lens:	4mm (78 or 92 degree) F : 2.0
Ambient Operating Temp:	-5 deg. C +40 Deg. C
Ambient Storage Temp:	-10 Deg. C+50 Deg. C RH 95% MAX
Dimension:	2 1/8" (L) x 1 1/4" (D)
Weight:	3 oz.





CAT NO	DESCRIPTION	PRICE EACH 1	5
WDB-5407S	Color Water Tight Bullet Camera	**$299.00**	**$269.00**

(water tight for outdoor use, not suitable for sustained underwater use)

CCD Bullet Cameras

new!

Available with standard or pinhole lens. Virtually indestructible bullet shaped casing. This sleek B&W camera can be mounted on walls or ceilings along narrow corridors or virtually any location for virtually any surveillance application. 0.5 lux minimum illumination with 380 lines of resolution. Even includes a built-in electronic iris for automatic light compensation.

Features

- Extremely low power consumption
- No blooming, no burning
- 0.5 LUX minimum illumination
- CCD area image sensor for long camera life
- Ultra small size allows for simple application and installation
- Built-in electronic auto iris for automatic light compensation
- Ultra compact camera

Specifications

Image Pick-Up Device:	1/3" CCD area sensor
No. of Pixels:	EIA = 512(H) x 492(V)
Pixel Pitch:	EIA = 9.6uM(H) x 7.5uM
Scanning System:	EIA=525 lines, 60 field/sec
Sync System:	Internal sync
H. Resolution:	430 TU line
V. Resolution:	400 TU line
Usable Illumination:	0.5 Lux F1.6
S/N Ratio:	More than 48dB
Gamma Characteristic:	0.45
Video Output:	1.0 - 1.1 up-p 75 Ohm
Electronic Shutter Time:	EIA=1/60 - 1/50,000 sec
Lens F No. Focal Length:	STD : 1.6 Open / 4.3mm(78 deg) Pinhole: 4.3 fixed/ 2.8mm(91.4 deg)
Power Consumption:	DC 9V (8-10V), 110mA
Operational Temp.:	-10 deg - +50 deg C RH95% max
Storage Temp:	-20 deg - +60 deg C RH95% max
Dimensions:	STD : 22mm(W) x 22mm(H) x 38mm(D) Pinhole: 22mm(W) x 22mm(H) x 30mm(D)
Weight:	35g max

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDB-07S	Standard Lens Version	**$144.00**	**$129.00**
WDB-07P	Pinhole Lens Version	**144.00**	**129.00**
WDP-07S/water	Standard Lens Weather Proof	**169.00**	**152.00**
WDP-07P/water	Pinhole Lens, Weather Proof	**169.00**	**152.00**

ESD Safe Soldering Stations

- *Auto-Temp 136ESD & Auto-Temp 137ESD*
- *Meets applicable military standards*
- *ESD safe featuring ceramic heating element and state of the art P.T.C. sensor to ensure accurate temperature performance*

Standard Tip

136ESD

137ESD w/ Digital R/O

Features

Fine Tune Temperature from 150° C (300° F) through 450° C (850° F) without unnecessary tip or heating element changes.

Precision "Tip Temperature" accuracy is mastered to within ±3° C (6° F) using state of the art circuit technology and a built-in P.T.C. sensor located at the top of each ceramic heater shaft for fail safe accuracy.

Fast Heat Up & Recovery. A long life Japanese made ceramic heating element facilitates fast heat up, fast recovery and exacting temperature control with minimal overshoot. Heat-up time to working temperature is attained in about 45 seconds. **Spike Free Circuit.** "Zero voltage" switching and fully grounded design meets military application standards for protection of electrosensitive devices against line transience and voltage spikes. Tip leakage is less than 0.4 mv or 0.5 ohm resistance. **External Calibration Port.** A calibration port is located on the face of the unit thus temperature adjustments are quick and convenient.

Lightweight Soldering Iron. Ergonomic mini handle that stays "cool". Handle assembly cord is made from silicone rubber that won't be damaged when coming into contact with high temperature irons.

Isolated Power Unit. The power unit is isolated from the AC line by a high quality transformer and only 24 Vac voltage is used to drive the heating element.

ESD Safe. Exceeds all soldering equipment military specifications regarding electro static sensitive devices for critical applications.

Lock-Out Feature: Constructed with a lock-out feature to allow supervisors only to set and lock specific soldering temperatures. Accomplished via a special sized allen head screw located on the front panel. **Superior High Insulation** ceramic heater provides insulation rated over 100Mohms at 750° F. **Optional SMD Tip Series** for re-work applications.

Range of Interchangeable Tips Available for maximum system flexibility.

CAT NO	DESCRIPTION	PRICE EACH 1	5
136ESD	Electronic Temp Controlled ESD Safe Soldering Station	**$99.00**	**$88.00**
137ESD	Electronic Temp Controlled ESD Safe Soldering Station w/ Digital Readout	**129.00**	**114.00**

CCD Dome Camera with Audio

B&W DOME camera with integrated microphone. Ideal security system application. 12 VDC operation.

new!

Specifications

Image Device:	1/3" interline transfer CCD
Picture Elements:	EIA=542(H)x492(V)
Scanning System:	2:1 Interlace
Synchronization System:	Internal
Horizontal Resolution:	380 TV Lines
Sensitivity:	Under 0.3 LUX
Electronic Iris (linear):	EIA = 1/60~1/100,000 sec
Video Output:	1.0vp-p, 75 ohm
S/N Ratio:	More than 50dB
Power Supply:	12V DC (±20%)
Gamma:	r=1
Power Consumption:	110 mA max
Operating Temp.:	-10°C ~ +50° C
Operating Humidity:	RH 95% Max
Weight:	100g
Applied Lens:	3.6mm -92°, 4.3mm -78°
AI/EE/Flicker Less/Mirror Image:	Jump soldering selection
Audio Pick-up Sensitivity:	-60dB (0dB=1V/ubar)
Audio Frequency Range:	20 Hz ~ 20 kHz
Audio S/N Ratio:	More than 40dB
Audio Output Level:	1Vp-p/600 ohm
Dimensions:	87 x 55.5mm

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDDB-6500	B&W Dome Camera	**$144.00**	**$129.00**

1/3" CCD Board Cameras

Available with **PINHOLE LENS** with **AUDIO**; **STANDARD LENS** with **AUDIO**; and **STANDARD LENS** with **INFRA-RED**. These are the world's smallest commercially available CCD board cameras!

World's Smallest B&W Board Cameras

Specifications

Image Pick-Up Device	1/3" CCD area Sensor
Picture Elements	EIA=512(H) x 492(V)
Pixel Pitch	EIA=9.6UM (H) x 7.5UM (V)
Scanning System	2 : 1 Interlace
Scanning Frequency	EIA=525 lines, 60 field/sec (II) 15.750 KHz x 60 HK
Resolution	430 Lines
Minimum Illumination	0.03 LUX
S/N Ratio	45DB
Lens Mounting	4.3mm standard, 5mm pinhole
Video Output	1.0 VP-P/750OHM composite signal
Power Requirement	8-12 VDC (9VDC standard)
Power Consumption	100mA
Operating Temperature	-20C -+ 70 C RH 95% Max
Storage Temperature	-40C -= 85 C RH 95% Max
Audio Pick-Up Sensitivity	-60 DB (0DB = 1B/UBAR. 1KNZ)
Audio Frequency Range	20 Hz to 20KHz
Audio S/N Ratio	More than 35DB
Audio Output Level	1VP-P/600 OHM

WDP-2000

WDS-2005

WDI-4000

Dimensions

WDP-2000	30mm (H) x 30mm (W)
WDS-2005	30mm (H) x 30mm (W)
WDI-4000	44mm (H) x 30mm (W)

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDP-2000	1/3" B&W Pinhole Lens with Audio	**$89.00**	**$77.00**
WDS-2005	1/3" B&W Standard Lens with Audio	**89.00**	**77.00**
WDI-4000	1/3" B&W Infra-RED (no audio)	**89.00**	**77.00**
WDPH-55BW	Plastic Housing Option for B&W Board Cameras (WDP-2000 & WDS-2005 ONLY)	**13.00**	**12.00**

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Antenna Rotator

Ideal for use with most TV antennas as well as smaller UHF and VHF Ham antennas. Adjustable mounting clamp accommodates masts up to 1½". Requires three conductor rotor cable (not included).

Order #	Description	(ea.)
30-1100	Rotator and control box	$39.95
30-1025	100' three conductor cable	12.95

Universal Desktop Rapid Battery Charger

Unique charge contacts accommodate nearly any type of Ni–Cad or NiMH battery. Ideal for Amateur Radio HTs, computer laptop, camcorder, cellular phone and many other batteries. Supports 4.8V, 6V, 7.2V, 8.4V, 9.6V and 12V charging. AC adaptor and automobile cigarette lighter included. Charge rate: 650/40mA. Discharge rate 400mA.

Order #	(ea.)
111-2801	$49.95

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Digital Laboratory Power Supply

Precision power supply is ideal for any service bench. Output voltage is variable from 0~30VDC, with adjustable current limiter from 0~3A. Switchable digital readout shows either current or voltage output. Coarse and fine adjustments provide precise adjustment.

Order #	Reg.	
72-2075	~~$249.00~~	$199.00

Remote Control A/B/C/D Switch

Four input remote controlled RF switch allows selection from up to four sources for output to TV or VCR, via infrared remote. Electronic switcher eliminates possibility of contact failure. Frequency range: 5MHz~2050MHz. Output and inputs are 75ohm "F" type connections. Remote requires two "AA" batteries not included (#290-070).

Order #	Reg.	
32-5190	~~$51.25~~	$39.95

Remote Control A/B Switch

Remote controlled RF switch allows selection from two sources for output to TV or VCR, via infrared remote. Electronic switcher eliminates possibility of contact failure. Frequency range: 5MHz~8900MHz. Output and inputs are 75ohm "F" type connections. Remote requires two "AA" batteries not included (#290-070).

Order #	Reg.	
32-4425	~~$25.75~~	$19.95

30 Piece Security Tool Set

This is a complete set of security bits for all of those difficult service applications, such as IBM PS/2 monitors, cable boxes, telephone equipment and many others. Kit contains security hex bits, security torx bits, spanner bits, tri–wings and more. Take the frustration out of those difficult service situations and save $15.00.

Order #	Reg.	
22-1475	~~$41.25~~	$19.95

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CSB 12V, 4Ah Sealed Lead Acid Battery

Ideal for most 12VDC and battery backup applications including alarm panels. Dimensions: 2.75" x 3.65" x 4.02". Weight 3.96 lbs. Connections via .187" tabs.

Order #	Reg.	
29-1910	~~$19.95~~	$14.95

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This 13.5VDC, 1 amp AC adaptor is perfect for use as a battery charger or to power projects.

Order #	(ea.)
58-3330	$3.99

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Special Purchase Video AB Switch

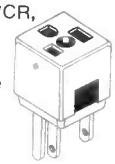
Jebsee # SW78S
Compact, shielded two position co-ax slide switch. Standard F connectors for 75 ohm input and outputs. Good quality assembly with solid switching action.

CAT# ABS-2

$1.75 each

10 for $15.00
100 for $100.00

PRICE REDUCTION! SL WABER "PowerMaster" Surge/Noise Suppressor



Protect your computer, phone, VCR, TV and stereo equipment from damaging transient voltage surges. Just plug in, and you've got full 3-line protection. Visual indicator lets you know that the device is functioning.
UL, CSA listed.
CAT # PW-103
Formerly $3.75

$2.75 each

S-VHS Tape (Used)

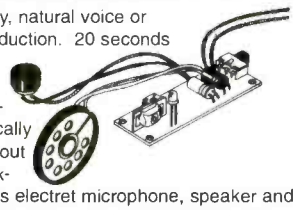
Super VHS tape users! Save a bundle on name-brand S-VHS, T-120 tapes. These tapes were used for a brief period, then bulk erased. The record-protect tabs have been broken out, so you will have to cover the notch with a piece of tape, but they work great and cost a fraction of the "new" price. Try some, you'll be back for more.

CAT #S-VHS

$3.00 each

10 for $28.00 • 100 for $250.00

Digital Voice Module

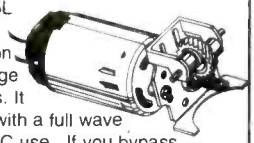


Good-quality, natural voice or audio reproduction. 20 seconds of record time. Stores message practically forever without battery back-up. Includes electret microphone, speaker and 4 AA battery holder. LED recording indicator light. Motion sensor switch plays recorded message when module is moved. Can be easily replaced with a pushbutton. 0.5uA standby current. 30 mA playback current. Board size: 1" x 2.4".

CAT # DVM-2000

$6.50 each

12 - 120 Vdc Worm Gear Drive Motor



CCL Motor # DE-25L
This very unusual motor will operate on any AC or DC voltage from 12 to 120 volts. It has been prepped with a full wave bridge rectifier for AC use. If you bypass the bridge rectifier it works very nicely on any DC power from 12 volts on up. The final drive is a 0.8" long worm gear that turns a 0.8" diameter plastic gear at 120 RPM @ 12 Vdc (no load). Replaceable brushes. Motor body is 1.41" diameter x 2.75" long.

CAT # DCM-96

$5.50 each

3 Volt Lithium Coin Cell

Panasonic # BR2330-1GU
3 volt, 255 mAh coin cell. Lithium batteries have a very long shelf life and are great for memory back-up protection. 0.9" diameter x 0.12" thick. 0.7" between positive and negative pc leads.

CAT #LBAT-16

2 for $1.50

20 for $12.00
100 for $45.00
1K for $300.00

RED Ultrabright LED

PAINFULLY BRIGHT RED LED
2500 to 4000 mcd @ 20 ma. These T 1 3/4 (5 mm diameter) red LEDs are significantly brighter than conventional LEDs. At close range, they are painful to look at. They are great for attention getting displays that can be seen from a distance. Water clear in off-state.

CAT # LED-42

2 for $1.20

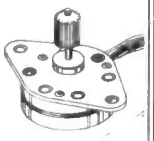
10 for $5.00
100 for $45.00
1000 for $400.00

High Brightness FLASHER LEDs

T 1 3/4 (5mm) high brightness RED LEDs with built-in flasher unit. 3-5 Vdc operation

CAT # LED-4 2 for 90¢
100 for $40.00 - 1000 for $300.00

Stepper Motor

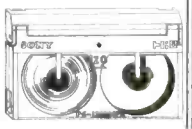


Airpax # LB82246
Unipolar, two-phase, 6 lead stepper motor. 500 ohm coil. 7.5 degrees per step. 1.4" dia. X 0.7" body. Oval mounting flange has holes on 1.65" ctrs. 0.08" (2mm) dia. shaft is 0.4" long and is fitted with a 0.31" dia. gear with 18 teeth. 15" leads.

CAT # SMT-28

$2.00 each

"HI-8" Video Cassette



SONY Hi-8 Top quality, metal particle 120 minute video cassettes. *Used for a short time, then bulk-erased.* Each cassette has its own plastic storage box.

CAT # VCU-8

$3.00 each

10 for $28.00
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CIRCLE 28 ON FREE INFORMATION CARD

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INSTRUCTIONS FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but, in all cases, full payment must accompany your order.

WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.75 per word. Minimum charge is $26.25 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Sorry, no discounts on credit-card orders. Boldface (not available as all caps),** add .40 per word additional. **Entire ad in boldface,** add 20%. **Tint screen behind entire ad,** add 25%. **Tint screen plus all boldface ad,** add 45%. **Expanded type ad,** add $2.25 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. POPULAR ELECTRONICS is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

CONTENT

All classified advertising in POPULAR ELECTRONICS is limited to electronics items only. All ads are subject to the publishers approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

AD RATES: $1.75 per word, Minimum $26.25

Send you ad payments to:
POPULAR ELECTRONICS 500 Bi-County Blvd, Farmingdale, NY 11735-3931

CATEGORIES

100 -- Antique Electronics	270 -- Computer Equipment Wanted	450 -- Ham Gear Wanted	630 -- Repairs-Services
130 -- Audio-Video Lasers	300 -- Computer Hardware	480 -- Miscellaneous Electronics For Sale	660 -- Satellite Equipment
160 -- Business Opportunities	330 -- Computer Software	510 -- Miscellaneous Electronics Wanted	690 -- Security
190 -- Cable TV	360 -- Education	540 -- Music & Accessories	710 -- Telephone
210 -- CB-Scanners	390 -- FAX	570 -- Plans-Kits-Schematics	720 -- Test Equipment

CLASSIFIED AD COPY ORDER FORM

Place this ad in Category #_____ **Special Category $20.00 Additional** _____

1 - $26.25	2 - $26.25	3 - $26.25	4 - $26.25
5 - $26.25	6 - $26.25	7 - $26.25	8 - $26.25
9 - $26.25	10 - $26.25	11 - $26.25	12 - $ 26.25
13 - $26.25	14 - $26.25	15 - $26.25	16 - $28.00
17 - $29.75	18 - $31.50	19 - $ 33.25	20 - $35.00
21 - $36.75	22 - $38.50	23 - $40.25	24 - $42.00
25 - $ 43.75	26 - $45.50	27 - $47.25	28 - $49.00
29 - $50.75	30 - $52.50	31 - $ 54.25	32 - $56.00
33 - $57.75	34 - $59.50	35 - $61.25	36 - $63.00
37 - $64.75	38 - $66.50	39 - $68.25	40 - $70.00

Total words _____ $1.75 per word = $_____

Bold Face _____ $0.40 per word = $_____

Special Heading _____ $20.00 = $_____

Other_____ = $_____

Total classified ad payment $_____ **enclosed**

TOTAL COST OF AD $ _____

[ ] Check [ ] Mastercard [ ] Visa [ ] Discover Card # _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ Expiration Date _ _/_ _

Signature_____

Name _____ Phone _____

Address_____City State Zip _____

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15 Days Money Back Guarantee!

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DMM-895 ($179.00): true rms, AC/DC (V,A), Ω, bar graph, freq, capac., dBm, logic, diode
DMM-885 ($149.00): AC/DC (V,A), Ω, bar graph, freq, capac., logic, diode
DMM-20 ($74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω, hFE, diode, duty cycle
DMM-22 ($89.95): 4000counts, bar graph, Freq, AC/DC(V,A), Ω, Capacitance, diode, contin.
DMM-23T ($99.95): 4½ digit, true rms, high resol. (10μV, 10nA, 10mΩ), hFE, diode, contin.
DMM-10 ($19.95): 3½ digit, DC/AC V, Ω, hFE, diode, signal output(+3V,-0.5Vsq.,50%duty)
DMM-113 ($24.95): Pocket Size, DC/ACV, Ω, diode, Continuity beeper
DMM-120 ($24.95): economy type, DCV,ACV, DCA, Ω, hFE, diode
DMM-122 ($59.95): DC/AC(V,A), Ω, hFE, diode, capacitance, freq, logic, continuity
DMM-123 ($44.95): DMM + capacitance, DC/AC(V,A), Ω, hFE, diode, continuity
DMM-124 ($69.95): Electrical+Temp,DC/ACV, Ω, capacitance, freq, 3 phase, diode, contin.
DMM-125C ($54.95): Autorange + bar graph, DC/ACV, Cap,Ω, diode, continuity beeper

LCR METER

CAP-15 *($49.95)*: 3½ digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution zero adjustment.
LCR-24 *($139.95)*: 0.1μH-200H, 0.1pF-2000μF, 0.01Ω-20MΩ, diode test. ***New Model.***
LCR-814 *($189.95)*: 0.1μH-200H, 0.1pF-20mF, 1mΩ-20M Ω, Q Factor, dissipation, zero adjust
LCR-131D *($229.95)*: autorange, 0.1μH-10kH, 0.1pF-10mF, 1mΩ-10MΩ, Q Factor, serial/parallel, 120Hz/1kHz testing mode.

FREQ. COUNTER

FC-1200 *($129.95)*: 1.25GHz Handheld, 8 digits display, 10ppm accurary, sensitivity 5mV (130-350MHz), 30mV (440MHz), 22mV (800MHz), batteries or 9V adapter.
FC-2500 *($179.95)*: 2.5GHz Handheld, 8 digits display, 4ppm accurary, sensitivity <50mV, batteries or 9V adapter.
FC-5270A *($149.95)* 1.2 GHz bench type, 8 digit, 10 ppm, 35mV sensitivity, 10Vp-p max. input, power by 9V adapter.
FC-5700 *($329.95)* 1.3GHz bench type, 8 digit, 1 ppm accuracy, 20mV sensitivity, period 0.1μs to 100ms. Ideal for test & repair of audio instrument.

FLUKE DMM

HandHeld		*Scope Meter*	
12B	$ 84.95	**92B-III**	$1,445
70-III	$ 85.00	**96B-III**	$1,695
73-III	$115.00	**99B-III**	$2,095
75-III	$139.00	**105B**	$2,495
77-III	$154.00	**123-III**	$945
79-III	$175.00	**863E**	$475
87	$289.00	**867B**	$650
87-III	$309.00		

SPECIALTY METERS

- Sound meter $169.95
- EMF Tester $69.95
- Conductivity $169.95
- Thermometer $69.95-$89.95
- Humid./Temp meter $169.95
- Press. meter $299.95
- Electr. scale $89.95
- Watt Meter $129.95
- High Voltgae Probe $59.95
- pH Meter $79.95
- Light Meter $80-$90
- Light Adapter $49.95
- Anemometer $179.95
- Anemometer adapter (And More) $89.95

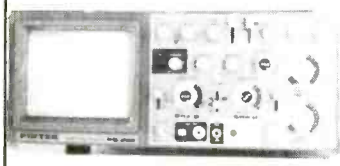
OSCILLOSCOPE

Dual Trace, Component Test, 6" CRT, X-Y Operation, TV Sync, CH2 Output, Graticule Illum, 2 Probes(x1;x10)

- PS-200 20 MHz Dual Trace $339.95
- PS-205 20 MHz Dual w/ Delay Sweep $429.95
- PS-400 40 MHz Dual Trace $494.95
- PS-405 40 MHz Dual w/ Delay Sweep $569.95
- PS-605 60 MHz Dual w/ Delay Sweep $769.95
- PS-1000 100MHz Dual Trace $999.95

Digital Scope:
- DS-303 30MHz Digital, 20 Samples/sec $849.95
- DS-303P RS-232 interface, 30MHz $1,049.95

Scope Probe:
HP-9060 (60MHz) $15, HP-9150 (150MHz) $22, HP-9250 (250MHz)$29, HP-9258 (250MHz,100:1)$39



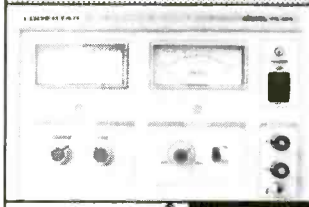
AUDIO/RF/FUNCT. GENERATOR

RF Generator
- **SG-4160** ($124.95) 100kHz-150MHz sinewaves in 8 ranges, 100mV at 35MHz
- **SG-4162** ($229.95): same as SG-4160, plus 6 digits int/ext freq. counter (150MHz).

Audio Generator
- **AG-2601** ($124.95)10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave
- **AG-2603** ($229.95): same as AG-2601, plus 6 digits int/ext freq. counter (150MHz).

Function Generator
- **FG-2100A**($169.95).2Hz-2MHz,5mV-20Vpp
- **FG-2102AD** ($229.95) same as FG-2100A, plus int. counter and TTL, CMOS output.
- **FG-2103** ($329.95) ***Sweep*** 0.5Hz-5MHz, linear/log, VCG, GCV, 6 dig. int/ext counter

POWER SUPPLIES



Single Output DC Power Supplies

- Short Circuit and overload protected
- Constant current, constant voltage mode
- 0.02%+2mV line regulation; 0.02%+2mV load regulate

Analog Meters Display
PS-303 ($159.00) 30V/3A
PS-305 ($219.95) 30V/5A
PS-8110 ($289.95) 60V/3A
PS-8112 ($399.95) 60V/5A
PS-1610 ($289.00) 16V/10A
PS-8107 ($399.95) 30V/10A

Digital Voltage, Analog Current
PS-8200 ($179.95) 30V/3A
PS-8201 ($239.95) 30V/5A

Digital Volt & Current Display
PS-8300 ($199.95) 30V/3A
PS-8301 ($259.95) 30V/5A

Dual Tracking

- Short Circuit & overload protected
- Constant current & voltage mode
- Independent or Tracking

Dual Tracking (Analog V & I Displays)
PS-303D ($314.95) 30V/3A/30V/3A
PS-305D ($399.95) 30V/5A/30V/5A
PS-8108 ($549.95) 60V/3A/60V/3A
PS-8109 ($699.95) 60V/5A/60V/5A

Triple Output

- One fixed 5VDC, 3 Amp output
- Parallel to double current output (PS-8102 & PS-8103 only)

Triple Output (Analog displays)
PS-8102 ($399.95) 30V/3A/30V/3A
PS-8103 ($489.95) 30V/5A/30V/5A

Digital Displays
PS-8202 ($499.95) 30V/3A/30V/3A
PS-8203 ($549.95) 30V/5A/30V/5A

GW/INSTEK® Test & Measuring Instrument

ISO 9002 Cert. #934163 (2 Years Warranty)

OSCILLOSCOPE

OS-658G $849.95 50MHz Cursor Readout | **OS-622G $369.95** 20 MHz Oscilloscope

- Dual CH / Delay sweep
- **Readout & Cursor meas**
- Built-in delay line
- Z-axis input,CH1 output
- TV syn., trigger level lock
- 2 probes (x1, x10)

- Dual CH/X-Y operation
- 1 mV/div sensitivity
- Z-axis input,CH1 output
- TV syn., trigger level lock
- 2 probes (x1, x10)

OS-305 ($229.95) - 5 MHz One Channel
OS-310 ($324.95) - 10 MHz One Channel

DC POWER SUPPLIES

Triple Output

- 2 variable out 0-30V,0-3A
- One fixed 5V,3A output
- Auto track, serial, parallel
- Const. volt, current mode
- 4 analog or 2 digital display

PC-3030 ($499.95)
PC-3030D ($549.95)

Single Output

- Const voltage, current mode
- Voltage regulation ≤0.01%
- Current regulation ≤0.2%
- PS: 2 analog or 1 digital disp
- PR: 2 analog or 2 digital disp

Analog Meters Display
PS-1830 ($209.95) 18V/3A
PS-1850 ($229.95) 18V/5A
PS-3030 ($219.95) 30V/3A
PS-6010 ($209.95)60V/10A
PR-3060 ($329.95)30V/6A
PR-6030 ($329.95)60V/3A
PR-1810H($349.95)18V/10A

Digital Meters Display
PS-1830D($229.95)18V/3A
PS-1850D($254.95)18V/5A
PS-3030D($254.95)30V/3A
PR-6030D($399.95)60V/3A

Programmable

- High stability, low drift
- One fixed 5V,3A output
- 100point program(PPS ser)
- 50point program(PPT ser.)
- Auto serial/parall (PPT ser)
- Auto track (PPT series), IEEE-488.2 and SCPI compatible command set (optional)

PPS-1860G ($1,149.95)
PPS-3635G ($1,149.95)
PPS-6020G ($1,149.95)
PPT-1830G ($1,499.95)
PPT-3615G ($1,499.95)

FG-830G ($1,799.95) 30MHz Synthesized Function Gen.
- Output: sine, tri., square, sync out, arb. waveform
- 20mHz Freq. resolution
- Linear/log sweep
- Arbitrary modulation
- RS232; IEEE-488(option)

FUNCTION GENERATOR

FG-8015G($179.95)Sweep
- 0.02Hz-2MHz,no counter
- Sine/Squ/Tri/pulse/Ramp

FG-8016G ($239.95)
- 0.02Hz-2MHz w/ counter
- Pulse, function generator

FG-8017G($249.95)Sweep
- Sine/Tri/Squ/TTL/CMOS
- 0.02Hz-2MHz, FM mod.

FG-8019 ($399.95) Sweep
- 0.02Hz-2MHz w/counter
- INT/EXT AM/FM mod

FG-8020G ($209.95)
- 0.02Hz-2MHz

FG-8050 ($499.95) Sweep
- 0.05Hz-5MHz w/counter
- INT/EXT AM/FM mod

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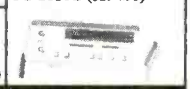

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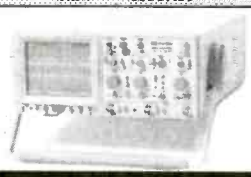

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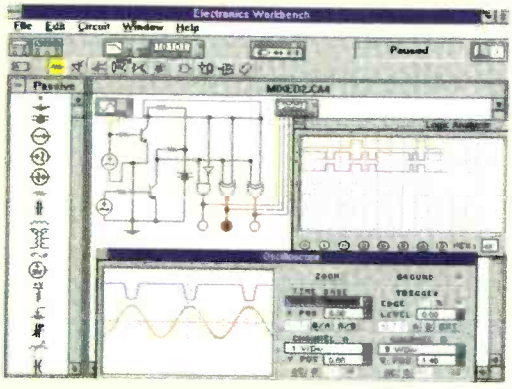

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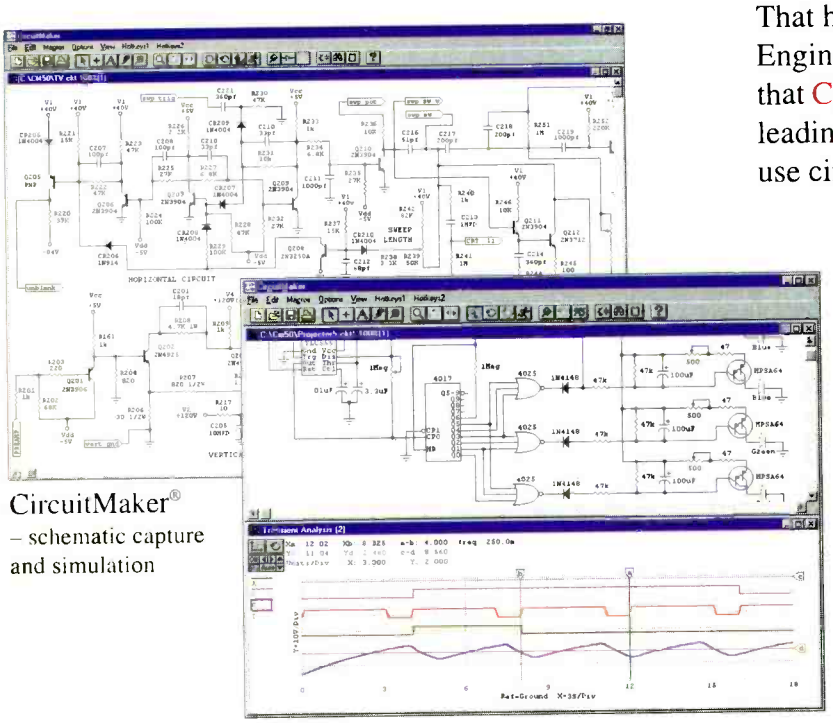

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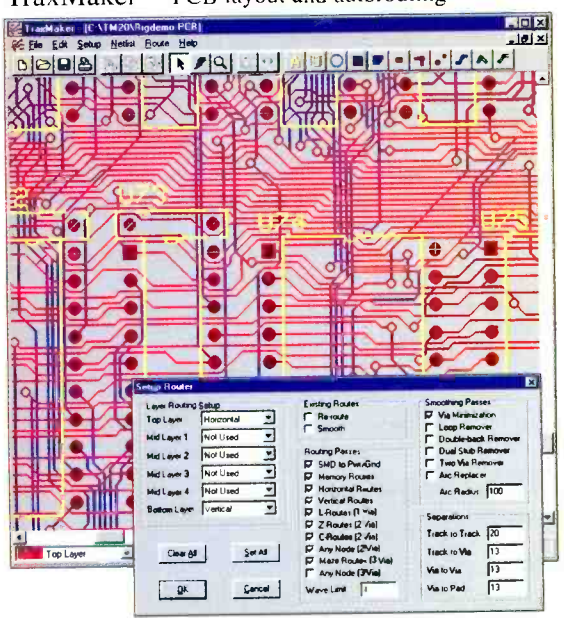

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